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The primary purpose is to determine the relative effectiveness of televised courses designed to provide genuine intellectual stimulation to gifted pupils in grades 10 through 12 in rural secondary schools. All aspects of the program are described in which a total of four courses were offered during the academic years 1959-60 and 1960-61 over three television stations covering most of the State of Maine. Courses were in science and mathematics. Approximately 700 students participating in the courses were divided into four treatment groups: television only, television plus monthly seminars with project teachers, television plus bi-weekly visits of project teachers, and television plus seminars and visits. Several standardized tests as well as some designed exclusively for use with the courses were used in evaluating the pupils' achievements. Results are analyzed with appropriate statistical techniques. Discussion includes: the research procedures utilized; evaluations of the student achievement and student attitudes; reaction of principals, and students of participating schools, college admissions officers, college teachers, and adult viewers; and some of the problems encountered in TV teaching. Those responsible for the administration of the research study are convinced that this project has demonstrated the feasibility of providing a genuine service to superior students in the smaller secondary schools.

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Intellectual Stimulation of Gifted Pupils in Small Secondary Schools Through Televised Instruction

Joseph J. Devitt, Chief, Bureau of Secondary Education
Maine State Department of Education

Title VII Project Number 032
National Defense Education Act of 1958
Grant Number 717007

State Department of Education
Augusta, Maine

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RESEARCH DESIGN

Courses	1959-1960	Concepts of Mathematics I Ch. III, p. 6 Science for the Space Age I Ch. III, p. 7
	1960-1961	Concepts of Mathematics II Ch. III, p. 6 Science for the Space Age II Ch. III, p. 7
Treatments		1. Television only 2. Television plus monthly seminars with project teachers 3. Television plus bi-weekly visits of project teachers 4. Television plus seminars and visits
Students		Selection Ch. III, p. 11 Number, sex, and grade level Ch. III, Table 2, p. 12
Schools		Size Ch. III, Table 1, p. 12 Number Ch. V, Table 60 and Figures 13 and 14, p. 90
Evaluation Instruments	Pre Measures	SCAT, Verbal and Quantitative Ch. III, pp. 14-15 STEP, Mathematics and Science Ch. III, p. 15; Ch. IV, p. 28, Figures 9-11, pp. 36-38 FAS Ch. III, p. 15; Ch. IV, pp. 80-81
	Course Measures	Unit and Final Achievement Tests Ch. III, p. 14; Ch. IV, Figures 2-8, pp. 25-34; and pp. 35-37 School Attitude Ch. IV, p. 81 Projects Ch. IV, pp. 38-39 Dropouts Ch. IV, pp. 81-88
	Post Measures	SCAT, Verbal and Quantitative Appendix A STEP, Mathematics and Science Ch. IV, pp. 35-38; Figures 9-11, pp. 36-38; FAS Ch. III, p. 15; Ch. IV, pp. 80-81 SUYSS Ch. III, p. 15; Ch. IV, pp. 39-45 Biographical Aspiration Inventory Ch. III, p. 16; Ch. IV, pp. 66-79 Course Attitude Questionnaire Ch. III, p. 16; Ch. IV, p. 45-66; Appendices B and C Principals' Evaluations Ch. IV, pp. 92-94 Consultants' Letters Ch. IV, pp. 17-21 Comments from Students in College Ch. IV, pp. 22-24

FOREWORD

The Nine O'Clock Scholar program was truly a cooperative venture. Whatever success it enjoyed is due in large measure to the unstinting cooperation of many agencies, groups, and individuals too numerous to list in full. Throughout the life of the project the advice of experts in their fields was sought whenever it was practicable to do so. Those responsible for the administration of the program constantly were amazed by the willingness of everyone approached to give so generously of his time to help make the study a success.

Among those to whom gratitude particularly should be expressed are staff members of the United States Office of Education for their advice, especially in the early stages of planning, and for their financial support; the several advisory committees which guided the development of the program; the management of the commercial television stations which made the project possible by devoting valuable time and their resources and facilities without charge; the colleges and commercial suppliers which lent valuable equipment; and the administrators and teachers in participating schools who cooperated so generously.

The project director also was impressed constantly by the dedication to their work of the full-time project staff members. The research director, the four master teachers, and the nine assistant teachers proved that they were competent, enthusiastic, and willing to give of themselves far more than anyone had the right to expect.

The project director is especially grateful to Dr. Robert F. Schweiker of Goddard College, Plainfield, Vermont, with whose guidance this report has been prepared. Dr. Schweiker also has reviewed the entire manuscript and has made numerous suggestions for improvement.

Two other persons who contributed a great deal to the preparation of this report are Peter Dionne, project assistant teacher who organized much of the interpretation of statistical data, and P. Alistair MacKinnon, chief of the Bureau of Research and Statistics, Maine State Department of Education, and his staff who assisted with the data processing.

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CHAPTER I. SUMMARY OF FINDINGS AND CONCLUSIONS

This chapter is a brief statement of the major findings and conclusions that are reported in greater detail in Chapters IV, V, AND VI. Persons unfamiliar with the study will find it helpful to read Chapters II and III before reading this summary.

Student Growth in Subject Matter

The testimony of college professors and recognized leaders among Maine's high school teachers of mathematics and science indicated general approval of the televised courses. The project teachers who worked with the participating students in their schools expressed belief that the program provided a profitable and challenging experience to the boys and girls. A follow-up of the students who had entered college after a year's participation in the televised mathematics course elicited a concensus of general appreciation of the value of the course.

Examination of the staff-constructed unit and end-of-course achievement tests and analyses of item difficulty indicate that the tests were well constructed. The mean percentage scores earned on these tests provide evidence that the pupils generally demonstrated satisfactory growth in the subject matter presented.

From these data it seems reasonable to conclude that through television it is possible to present full-year courses which will desirably affect academically talented secondary-school students.

Need for Supplementary Assistance from Teachers

Comparison of the mean scores on achievement tests of students who had only the televised instruction with the scores of students who had monthly seminars or bi-weekly visits conducted by project staff members or both led to the following conclusions:

1. Capable students who take a televised course such as the two presented in mathematics will learn somewhat more if they have some supplementary assistance from teachers who are competent in the subject matter presented. These pupils do not need a great deal of help; a little will suffice.
2. Capable students in a televised course like the two presented in science can do as well without supplementary help from teachers trained in the subject matter presented as can pupils who have this additional aid.
3. These two conclusions suggest that pupil need for assistance supplementary to the televised instruction is dependent in part upon the nature of the subject matter of the course.

Attitudes of Participating Students toward the Televised Courses

Little correlation was found between student liking for the televised courses and the amount of supplementary assistance provided.

Generally the students reported that they spent less time in completing the assignments and in other related study than they did in their regular courses in English, mathematics, and science. The televised courses to a somewhat lesser extent than conventional courses prevented pupils from participating in activities which they would have preferred.

The pupils as a whole reported that they found the televised courses more difficult than their regular school subjects and the amount of supplementary services provided by assistant teachers did not affect significantly this evaluation. On the other hand, the pupils indicated that they thought the televised courses were less valuable than their regular school subjects.

Students generally stated that the televised lessons were less clear and less understandable than their regular classes, and this evaluation did not vary significantly in proportion to the amount of supplementary help received.

Students while enrolled in the course indicated that they believed they learned less than in their conventional courses.

These data suggest that the students, while they were enrolled in the televised program, generally held these courses in less esteem than their regular school subjects. A part of this may be due to the fact that most students took the televised courses in addition to a full schedule of conventional classes. They probably realized that the experimental courses were an extra burden which they did not need to assume to qualify for college admission. It is interesting to contrast this attitude with the high level of appreciation of the value of the course content expressed by the same students after they had had some experience in college.

Changes in Educational and Vocational Goals

The data obtained in four questionnaires show that as a group the pupils participating in the televised courses were good students and had formulated relatively stable educational and vocational plans. They were taking about all the college preparatory science and mathematics courses offered in their schools. They wanted to attend college and enroll in engineering, physical science, and mathematics courses.

The boys and girls with whom these pupils spent most of their free time also wanted to attend college. Relatively, they were not influenced greatly by the opinions of their home or their school.

The questionnaires indicate that during the year the pupils' educational and vocational aspirations and plans did not change substantially. Their attitudes toward the subject areas represented by the televised courses already were favorable when they enrolled. The small indication of change that was evident was generally favorable to mathematics and science.

Attitudes of Principals of Participating Schools

Principals of more than one-third of the schools within the viewing area registered students for the 1959-1960 courses. Thirty-six of these schools enrolled in 1960-1961. This suggests that the principals were satisfied that the courses were sufficiently worth while to justify the expenditures of their own and their students' time and effort to permit participation. The addition of 16 new schools in the second year is evidence that the courses were establishing a reputation for quality.

The majority of principals stated in a questionnaire that the program provided broader and deeper course content than was otherwise possible in small schools. They also expressed approval of the high quality of teaching and lesson planning. The two greatest difficulties they reported were the lack of sufficient opportunities for face-to-face contact between the television teacher and the pupils and the difficulties of local scheduling.

Attitudes of College Admissions Officers

College admissions officers in Maine were friendly to the project. They did not want students to take a televised course in lieu of a conventional course in advanced mathematics or laboratory science taught by a highly qualified teacher. Nevertheless, they encouraged students to enroll for the enrichment value of the televised program, even in the larger schools.

During the second year the University of Maine announced that it would accept the Concepts of Mathematics course in lieu of a regular course in trigonometry, particularly for students from the smaller schools.

Attitudes of Adult Viewers

The official enrollment of more than 600 adults is evidence that the courses were approved by home viewers.

Housewives, retired men and women, self-employed persons, and even some teachers in double-session schools wrote hundreds of unsolicited letters of appreciation of the quality and value of the program.

Problems of TV Teaching

The most important problem seemed to be enlistment of participation. In a state which has had little educational television, and no in-school programs at the secondary-school level, the value of educational television must be demonstrated to school administrators and teachers. The satisfactory participation in 1959-1960 was obtained by a vigorous promotional campaign which included numerous news letters, a state-wide series of meetings, distribution of 10,000 descriptive brochures, personal visitations, and telephone calls.

A second problem was caused by the difficulty in adjusting local school schedules with the telecast period. Since this was not always practicable, especially in schools with rotating schedules, special provision had to be made in most schools to release students from a regular class before the period had ended and to admit others to a class after it had started. Related to this problem was the difficulty, particularly in the smaller schools, of freeing a teacher to supervise the students during the television lessons.

A third obstacle to successful participation was the fact that most students took the televised courses in addition to a full schedule of conventional classes. Some students had as many as seven academic subjects, including one or both televised courses. Since the experimental courses were designed to challenge the best efforts of the pupils, six or seven classes was a heavy burden.

A fourth problem was that of adjustment by the television teacher to the new experience of teaching before a camera. The lack of face-to-face contact with his students and the difficulty of knowing whether the pace was too fast or too slow created psychological tension that was difficult to overcome.

The prime teaching problem, recognized alike from the very beginning by both the project administrators and the teachers, was the production of courses of really high quality. Great care was exercised in obtaining really competent teachers. Each television teacher was given adequate assistance by staff members employed for this purpose. College and secondary-school teachers of mathematics and science were consulted whenever practicable to ensure high quality and accuracy. Preparation for teaching was given first priority over all other phases of the research program.

Conclusion

Those responsible for the administration of the research study are convinced that this project has demonstrated the feasibility of providing a genuine service to superior students in the smaller secondary schools that cannot be duplicated by their own schools. Full-year academic courses geared to the aptitudes and abilities of these pupils can be taught successfully through television. When the courses are telecast on a state-wide or regional basis, and when schools generally participate, the per pupil cost is low. When the television teaching is well done, pupils do not need supplementary assistance from teachers competent in the subject matter presented.

For maximum success such a program requires fulfillment of the following conditions:

1. Production of courses of truly high quality, through employment of a competent teacher, and providing him with sufficient assistance, equipment, and materials.
2. Provision for the televised course to replace one of the students' regular classes.
3. Adjustment of the school schedule to eliminate conflict between the time of the telecast and the students' regular classes.
4. A friendly and cooperative attitude on the part of local school personnel toward the televised courses — a word of encouragement is more important than subject-matter assistance.
5. Assignment of school personnel to proctor the television lessons.

CHAPTER II. PURPOSE OF THE STUDY

Specific Objectives

The primary purpose of this study is to determine the relative effectiveness of televised courses designed to provide genuine intellectual stimulation to gifted pupils in grades 10 through 12 in rural secondary schools. To achieve this purpose, answers to the following questions were sought:

1. Can a competent television teacher stimulate gifted pupils to the extent that significant changes may be observed in their learning attitudes, educational plans, and vocational aspirations?
2. When television instruction is provided to gifted pupils with varying amounts of supplementary assistance, will significant differences be observed in the achievement of these pupils in the subject matter taught?
3. To what extent can gifted pupils learn through television without supervision by teachers who possess competence in the subject taught?
4. What are the effects of varying amounts and kinds of instructional assistance in stimulating voluntary additional learning by gifted pupils in the subject taught by television?

Need for the Study

States and communities throughout the nation are faced with the problem of developing educational programs that will provide genuine intellectual stimulation to gifted secondary-school pupils.

Three approaches to the solution of this problem generally are offered—acceleration, enrichment, and special classes.

Acceleration requires careful planning to ensure that serious gaps do not occur in the mastery of essentials of both the elementary and the secondary-school curricula. This type of planning, involving cooperation between the teachers at different grade levels, is not common in the smaller schools in rural areas. Despite the reports of those who have developed programs of acceleration, as exemplified by Rt. Rev. Clarence Elwell's article, "Acceleration of the Gifted" in *The Gifted Child,* [1] there is room for doubt concerning the value of this type of program in rural areas.

Most of the literature concerning education of gifted children describes enrichment programs. Enrichment usually provides for relatively intensive study of topics being more summarily dealt with by the other members of the class. It consists of semi-independent exploration of special interests, more extensive and more critical reading of materials related to the class topic, creative activities, some release from classroom routine, and leadership roles in class projects.

Enrichment activities frequently are advocated as the most promising means of stimulating brighter children to achieve nearer to their potential, particularly in the smaller schools. To be successful, however, this technique requires adequate time for planning and preparation by the teacher. In the smaller, rural secondary schools, teachers generally do not find sufficient time for this purpose because of often inadequate training, multiple subject preparations, and heavy extra-curricular responsibilities. The writer is also convinced that the absence of the stimulus of competition with their intellectual peers prevents some able pupils from responding to the efforts that are made by the teachers.

"Teaching Rapid and Slow Learners in High Schools" [2] identifies still another reason why enrichment programs are difficult in small schools. The bulletin states, "There is often conscious or subconscious pressure on the teacher to bring the below-average pupil up to class norms; for the teacher is aware that the child's academic deficiencies may make her the target of criticism from parents as well as from principals and later teachers of the child." This pressure reduces the time available to teachers to develop enrichment programs for able pupils who will "get along" without special teacher care.

In the opinion of the writer, the most satisfactory solution to the problem is the formation of special classes of very able pupils. Many types of grouping of gifted children for specialized instruction have been attempted. Examples include the "track" system of ability grouping of pupils (recommended among others by the Maine State Curriculum Committee), "honors" courses in one or more subjects, "integration seminars" of gifted children from several grade levels to meet regularly with a panel of teachers for intensive study, the "major work" plan of the Cleveland Public Schools, extended reading programs, and the relatively new but rapidly growing "Advanced Placement Program." However, even if qualified teachers were available in sufficient numbers, there are not enough gifted children available in small schools to make the formation of special classes practical.

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[1] Rt. Rev. Clarence Elwell, "Acceleration of the Gifted." *The Gifted Child,* Vol. II, No. 2, Spring, 1958.

[2] U. S. Office of Education, U. S. Department of Health, Education and Welfare, *Teaching Rapid and Slow Learners in High School,* Bulletin 1954, No. 5

Some educators recommend that the use of the grouping technique, so common in the elementary schools, be extended to the high school, and that there be organized in each class section a small group of more able pupils. This proposal generally is resisted by most secondary-school teachers.

Apparently there is no solution to this problem that is widely accepted as adequate. It is a national problem which is particularly acute in rural areas. It is typified by the rural communities in the State of Maine.

This study has been made by the Maine State Department of Education as a means of developing and testing a practical and economical program for stimulating the educational achievement of these able pupils.

CHAPTER III. RESEARCH PROCEDURES

Two full-year courses in mathematics and science were taught both in 1959-60 and 1960-61. Each was televised for thirty minutes daily, Monday through Friday, for a total of 175 days, beginning in September and ending early in June. They were viewed by participating students in their own schools. Each course carried one Carnegie credit toward graduation.

During the initial planning of the project, extensive use was made of the advice of four groups of competent specialists. The advice and assistance of members of these four committees were sought continuously during the life of the project at all practicable opportunities.

A general advisory committee consisting of a representative group of educators and other interested persons met several times during the summer of 1959 and during the first few months of the program. This committee gave valuable advice concerning such tasks as staff recruitment, enlistment of school participation, public relations, and the many other problems involved in launching the two courses successfully.

College professors and recognized leaders among Maine's high school teachers of mathematics and science met with project staff members to help plan the content of the two courses. Responses to a request for suggestions sent to all schools aided in this task. In addition, several of the advisory committee members reviewed and suggested revisions of the course outlines and unit tests as they were developed during the two years.

A group of nationally recognized test experts came to Maine twice to help in developing the testing program and to advise concerning the interpretation and use of evaluation data. The advice of individual members of this committee was sought at several times during the study.

The program was known as the " Nine O'Clock Scholar." The first-year courses were entitled " Concepts of Mathematics I " and " Science for the Space Age I," the second-year courses, " Concepts of Mathematics II " and " Science for the Space Age II."

Course Content

Concepts of Mathematics I (six units)

Unit I (3 weeks) included a brief history of numbers, including simple and multiplicative grouping systems, number exercises involving various number bases, module arithmetic, congruence relations, and a comparison of some of the postulates and theorems of Euclidean geometry with those of Lobachevskian and Riemannian geometry.

Unit II (8 weeks) developed logic as a system of mathematics by deriving and proving theorems based upon a few assumptions, definitions, and undefined terms. Propositions, implications, propositional functions, truth tables, and syllogisms were a part of the material taught in this unit.

Unit III (5 weeks) presented set theory notation, properties and operations, cartesian sets, and the graphing of solution sets.

Unit IV (8 weeks) undertook the development of the number system from the foundation of Peano's assumptions through natural numbers, integers, rational numbers, real numbers, and complex numbers.

Unit V (4 weeks) dealt with the algebraic structures of groups, rings, and fields. The theorems that were proved in this unit ranged from those exhibiting the properties of multiplication by negative numbers to theorems involving inequalities.

Unit VI (8 weeks) consisted of probability and statistics, including symbols of logic, and problems involving combinations and permutations.

Concepts of Mathematics II (seven units)

Unit I (3 weeks) was devoted to topology, and included the Koenigsberg bridge problem, definitions of a topological transformation, classification of surfaces, and solution of several classical problems.

Unit II (2 weeks) reviewed the material presented the preceding year in number bases and a diagram of the number system.

Units III, IV, and V (17 weeks) consisted of set notations and functions, trigonometric functions, and exponential and logarithmetic functions. Trigonometric functions were introduced through the use of a winding function which resulted from wrapping the real number line around the unit circle. Logarithmetic functions were introduced as the inverse of exponential functions.

Unit VI (12 weeks) was devoted to vectors and matrices from solutions of sets of equations through the algebra of vectors.

Unit VII (2 weeks) consisted of an introduction to the mathematical theory of games.

Science for the Space Age I (six units)

This course presented selected topics in physics, earth science, geology, astronomy, chemistry, metallurgy, and biology in six units.

Unit I—Physics (13 weeks) had as its theme the orderliness of nature. The content ranged from Euler's law through foundations of modern atomic theory and the particulate composition of light and electricity to a study of radioactivity, including isotopes, fission, and fusion.

Unit II—Astronomy and Propulsion (4 weeks) presented material on radio and optical telescopes, star composition and life cycle, spectroscopy, variable stars, and inter-galactic space. A final section was devoted to gyroscopes, and jet and rocket engines.

Unit III—Earth Science and Geology (5 weeks) discussed the formation and structure of the various layers of the earth, the effects of subsurface and running surface water, the geological effects of ice, volcanic activity, and diastrophism.

Unit IV—Chemistry (10 weeks) emphasized the physical aspects of chemistry. Reviewed were the successive theories of electron arrangement, levels of subatomic activity, periodic charts, formation of chemicals through chemical bonding, colligative properties of solutions and colloids, the mathematics of chemical equilibrium, and detailed stochiometric calculations.

Unit V—Metallurgy (2 weeks) briefly described the processes involved in the industrial production of steel, copper, magnesium, and aluminum.

Unit VI—Biology (2 weeks) presented some of the basic properties of living matter. A description of the Darwinian concepts was followed by a study of genetics, the DNA molecule, mitosis and meiosis, and hereditary factors. Considerable time was devoted to studies of the evolution of traits in mice.

Science for the Space Age II (nine units)

The overall objective of this course was to explore with the participating students some of the problems that may be expected in launching a manned space vehicle into orbit around the earth.

Unit I (4 weeks) consisted of a refresher unit in mathematics, designed to compensate for the dissimilarity in the mathematical backgrounds of pupils from three different grades.

Unit II—Kinematics (10 weeks) developed man's understanding of the phenomena of motion from the Aristotelian concepts through vector and scalar quantities to projectile motion.

Unit III—Dynamics (5 weeks) developed concepts of momentum, the conservation of momentum, impulse, and the relation of these particular concepts to projectile and rocket motion.

Unit IV—Statics (2 weeks) presented the concept of torque and center of mass, relating these concepts specifically to the spin rockets on a multi-stage rocket and the flight stability of a specific rocket.

Unit V—Rotational Motion (1 week) included the rotational counterparts for linear distance, velocity, and acceleration; contripetal acceleration and contripetal force; and the earth's rotational motion on the acceleration caused by gravity.

Unit VI—Astronomy (4 weeks) reviewed the contributions in astronomy by Plato, Copernicus, and Kepler, and developed from Newton's law of gravitation and the previously derived equation expressing centrifugal force, a mathematical expression to predict the velocity required to orbit a satellite at a specific altitude above the earth's surface.

Unit VII—Propulsion and Space Navigation (4 weeks) presented the historical development of reaction engines from Hero's Aeolipile to modern jet engines, the factors involved in designing rocket engines, and extensive consideration of solid and liquid fuel rockets.

Unit VIII—Electronics (4 weeks) include some basic information relating to vacuum tube circuits and transistorized circuits, fundamentals of alternating current circuits (both capacitative and inductive), time constants, oscillation, and wave propagation.

Unit IX—Radiation Biology (2 weeks) presented the genetic effects of radiation, typical syndromes associated with varying degrees of radiation exposure, and personnel and area monitoring instruments.

Project Staff

Nine persons were employed full time. Several others contributed part-time services to the project.

The project director exercised overall supervision of the study on a part-time basis while carrying on his regular work as a staff member of the Maine State Department of Education.

A full-time research director was responsible for development of the details of the experimental pattern, administration of the entire testing program, and helping to evaluate the success of the experiment in achieving its objectives.

The teaching teams, one in science and one in mathematics, each consisted of a television teacher and three assistants, all of whom were certified teachers. Their task was to build and present the courses on television, conduct the seminar and school visitation service, prepare study guides, and build and score the achievement tests.

An experienced commercial television man was employed part time to handle liaison with the commercial television stations and to provide technical advice to project staff members. This person coached the television teachers in studio behavior and assisted in the technical aspects of script preparation, use of equipment on television, and generally facilitated the televising of the courses.

Each participating school named one faculty member as local coordinator. This person provided the channel for all communication between students and project staff members. He identified the pupils who would participate, distributed the teaching guides, administered the tests, arranged for the visiting teachers to meet with the students, and made arrangements for the seminars.

Studio Facilities

Concepts of Mathematics originated live in WGAN-TV, Portland, was taken from the air for simultaneous telecast by WABI-TV in Bangor, and was transmitted by a privately owned and operated micro-wave relay system for telecasting by WAGM-TV in Presque Isle. The program was taken from the air by WENH-TV, Durham, New Hampshire, and made available to New Hampshire schools.

Science for the Space Age originated live in WCSH-TV, Portland, was retelecast by WLBZ-TV, Bangor, WAGM-TV, Presque Isle, and WENH-TV, Durham, New Hampshire. The only change during the second year was that the New Hampshire station did not carry the science course.

WGAN-TV, Channel 13, is owned by the Guy Gannett Publishing Company and operated by the Guy Gannett Broadcasting Services. Its authorized video power is 316,000 kilowatts, and audio, 158 kilowatts. Its 1619-foot antenna is on Brown Hill, in Raymond, Maine.

WGAN has two studios. The main studios have two General Electric cameras. A sidewalk studio had an RCA camera which could be adapted for remote use. The Concepts of Mathematics lessons were usually done with one camera and the projector chain.

WGAN'S coverage reaches 251,700 families with a total of 190,000 television sets.

WCSH-TV, Channel 6, is owned and operated by the Maine Radio and Television Company. Its video power is 100,000 watts and its audio power 70,000 watts.

In the WCSH studio, two RCA image Orthicon cameras were available and were used for many of the programs. Two RCA Iconoscope film camera chains, dual slide projectors, screening and editing facilities were also available and were used from time to time. A studio area in a 25′ by 40′ room was set up permanently for Science for the Space Age with AC and DC outlets and running water.

The originating stations each made one director from their staff and one cameraman consistently assigned to the programs. Another camera and operator were added at the discretion of the director and the television teacher. One of the teaching staff (the alternate teacher) acted as floor man on all programs. The art and photography departments of WCSH-TV were often utilized to supply illustrative or visual material. A quick run-through preceded the on-air program each day with the program being followed by consultation by the television teacher with the directors and cameramen regarding the lesson for the following day.

Through arrangements with the commercial operators it was possible to defray the costs of production items consumed during the course of the program for a fee of $15 per week. The advertising cost at this time of day would normally be $175 per half-hour.

Figure 1 shows the areas of Maine which receive a satisfactory signal from the five commercial television stations. The data for this map were supplied by the stations.

Instructional Materials

All students in the first year of Concepts of Mathematics were required to have one basic textbook. It was strongly recommended that the pupils in each school have access to three additional texts, which were needed for optional related study. In the second year, two basic textbooks were required, one for each semester. Four books were recommended as supplementary texts.

In both years the material presented during the first four weeks of Concepts of Mathematics was summarized and

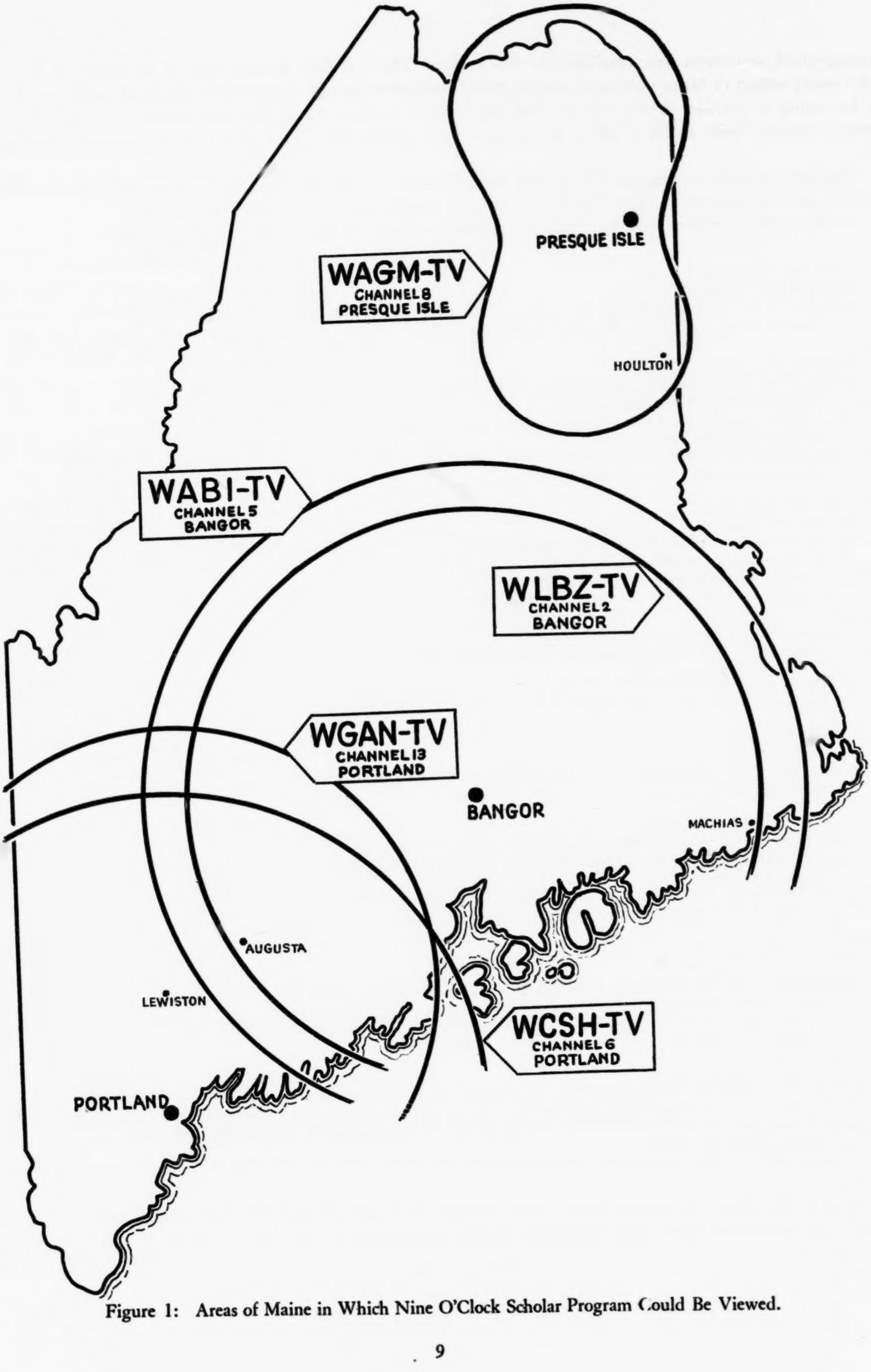
WAGM-TV
CHANNEL 8
PRESQUE ISLE
PRESQUE ISLE
HOULTON
WABI-TV
CHANNEL 5
BANGOR
WLBZ-TV
CHANNEL 2
BANGOR
WGAN-TV
CHANNEL 13
PORTLAND
BANGOR
MACHIAS
AUGUSTA
LEWISTON
WCSH-TV
CHANNEL 6
PORTLAND
PORTLAND

Figure 1: Areas of Maine in Which Nine O'Clock Scholar Program Could Be Viewed.

mimeographed, and copies were distributed to each student. This was done because some of the schools in the Aroostook County section of Maine close each year the last of September through early October to permit pupils to help with the harvesting of potatoes. It was believed that this written summary would help the students who because of this " potato vacation " were unable to follow the televised course at this time. This procedure also facilitated late registration.

One basic textbook was required in the first year of Science for the Space Age, and three were recommended for frequent use as supplementary texts. Extensive use of one scientific periodical was also encouraged.

In the second year there were two books for required reading, and two supplementary textbooks.

Science for the Space Age I
  Required for each pupil:
  Cheronis, N. D., Parsons, J. B. and Ronneberg, C. E., THE STUDY OF THE PHYSICAL WORLD.
    Third edition. New York: Houghton Mifflin Co., 1958.

  Recommended for easy access:
  Bonner, F. T. and Phillips, M., PRINCIPLES OF PHYSICAL SCIENCE. Reading, Mass.:
    Addison-Wesley Publishing Co., 1957.
  Frey, Paul R., COLLEGE CHEMISTRY. Second edition. Englewood Cliffs, N. J.:
    Prentice-Hall, Inc., 1958.
  White, Harvey E., MODERN COLLEGE PHYSICS. Third edition. New York: D. Van Nostrand Co., 1956.
  Periodicals such as the " Scientific American."

Science for the Space Age II
  Required for each pupil:
  Holton, Gerald and Roller, D.H.D., FOUNDATIONS OF MODERN PHYSICAL SCIENCE.
    Reading, Mass.: Addison-Wesley Publishing Co., 1958.
  Radio Corporation of America, ATOMIC RADIATION. Volumes I and II.
    Camden, N. J.: RCA Service Co., 1959 and 1960.

  Recommended for easy access:
  Baker, Robert H., INTRODUCTION TO ASTRONOMY. Fifth edition. Princeton, N. J.:
    D. Van Nostrand Co., 1957.
  Everitt, W. L., FUNDAMENTALS OF RADIO AND ELECTRONICS. Second edition.
    Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1958.

Concepts of Mathematics I
  Required for each pupil:
  Allendoerfer, C. B., and Oakley, C. O., PRINCIPLES OF MATHEMATICS.
    New York: McGraw-Hill Book Co., 1955.

  Recommended for easy access:
  Adler, Irving, THE NEW MATHEMATICS. New York: The John Day Co., 1958.
  Eves, Howard, AN INTRODUCTION TO THE HISTORY OF MATHEMATICS. New York:
    Rinehart and Co., 1953.
  Stabler, Edward R., INTRODUCTION TO MATHEMATICAL THOUGHT. Reading, Mass.:
    Addison-Wesley Publishing Co., 1953.

Concepts of Mathematics II
  Required for each pupil:
  Allendoerfer, C. B. and Oakley, C. O., PRINCIPLES OF MATHEMATICS. New York:
    McGraw-Hill Book Co., 1955.
  School Mathematics Study Group, MATHEMATICS FOR HIGH SCHOOL: INTRODUCTION TO MATRIX ALGEBRA.
    Revised. New Haven, Conn.: Yale University Press, 1961.

  Recommended for easy access:
  Bell, Eric T., MEN OF MATHEMATICS. New York: Simon and Schuster, Inc., 1937.
  Moore, John T., FUNDAMENTAL PRINCIPLES OF MATHEMATICS. New York: Rinehart and Co., 1960.
  Sloan, Robert W., AN INTRODUCTION TO MODERN MATHEMATICS. Englewood Cliffs, N. J.:
    Prentice-Hall, Inc., 1960.
  Williams, John D., THE COMPLEAT STRATEGYST. New York: McGraw-Hill Book Co., 1954.

Study guides called " assignment sheets " were mimeographed and provided for each student each year in both courses. The assignment sheets contained specific required assignments for each day, plus optional supplementary readings.

A portable demonstration table was used in presenting the science course. Science equipment was generously loaned by several Maine colleges, many science equipment manufacturers and governmental agencies. The total value of the science equipment borrowed without charge during the two years was estimated at $13,772.

Extensive use was made both years by the science staff of "flips," prepared by assistant teachers, and in some cases by Gorham State Teachers College students. These consisted chiefly of line drawings and diagrams on poster cardboard, using a felt pencil and indelible black ink.

Photographs and diagrams from several magazines and from college collections were used to illustrate many of the lessons. Slides and film clips were used to clarify points, also.

The mathematics teachers used two chalkboards extensively. During the first year a large demonstration slide rule was also used. The mathematics staff made limited use of slides and films, but used extensively charts, graphs, and tables which they constructed themselves. They also used such demonstration equipment as plastic models of polyhedra; rubber sheets, string, and torus in topology demonstrations; cardboard discs and string to illustrate wrapping a real number line around a circle; cardboard models of planes intersecting solids in the third dimension; and a model of a hypothetical four-dimensional figure.

Selection of Students

In the first announcement to schools, the two courses were declared to be open "officially" to pupils in grades 10, 11, and 12 who had an I.Q. of 120 or higher and who had superior reading ability. Responsibility for identifying these students initially would rest with each school. It was also announced that schools might enroll, at their own discretion, pupils who did not meet the requirements but who their principals believed would profit from participation. These pupils would receive all of the services provided to all students, but those responsible for planning the project intended to omit statistics concerning their performance from the research analyses.

Because of the lack of a statewide testing program, it soon appeared to be impractical to define "superior reading ability." The criterion of an Intelligence Quotient of 120 was easier to use but was not really satisfactory because of the wide variety of tests used in the schools.

At the suggestion of the Test Advisory Committee, this method of selecting students was abandoned and the following system was adopted and used during both years. Principals were asked to enroll only those pupils who were among the top ten per cent of their classes. Each school had the privilege of developing its own criteria for determining which pupils were in this group. They were urged, however, to be quite selective in grade 10 and more liberal in grade 12. All of the pupils enrolled in the courses were included in the research studies.

Participation

The procedures employed to enlist participation in the program are described in Chapter VI because obtaining sufficient numbers of schools and pupils constituted one of the most important problems confronting the project staff.

Schools

There were in 1959-60 a total of 163 public and 52 private secondary schools in Maine which included in their organization grades 10, 11, and 12. Thirty of the public and 4 of the independent schools were located in communities where a satisfactory television signal could not be received.

Of the 133 public schools which were able to receive an adequate picture, 54 (40.6%) participated officially throughout the year; of the 48 academies, 11 (22.9%) were enrolled for the year.

In 1960-1961 the number of public secondary schools within the viewing area had increased to 135 but the number of private schools had decreased to 46. The number of participating public schools decreased to 45 (33.3%), and the number of academies to 7 (15.2%).

The reasons for the decrease in enrollment in the second year are discussed in Chapter V.

In 1959-1960 participation was quite evenly distributed in terms of school size. Fewer than five per cent of the schools had enrollments above 1000 pupils, but these large schools constitute only 2.8 per cent of the total number of secondary schools in the state.

In 1960-1961 the percentage of large schools decreased and the percentage of both medium-sized and small schools increased. Almost half of the schools in both years enrolled fewer than 200 pupils, and almost two-thirds enrolled fewer than 300 pupils.

TABLE 1
Size of Participating Schools

Enrollment Grades 9-12	1959 - 1960 Number of Schools	1959 - 1960 Per Cent	1960 - 1961 Number of Schools	1960 - 1961 Per Cent
1000+	3	4.6	–	–
500 - 999	11	16.9	8	15.4
300 - 499	11	16.9	10	19.2
200 - 299	12	18.5	11	21.2
100 - 199	16	24.6	12	23.1
25 - 99	12	18.5	11	21.2
Totals	65	100.0	52	100.1
χ^2	8.6125		3.7254	

Throughout this report in Chi-Square values, t-ratios, and coefficients of correlation, a single asterisk indicates significance at the five per cent level; a double asterisk, significance at the one per cent level.

TABLE 2
Distribution by Sex, Grade Level, and Treatment Group of the Students Who Completed the Televised Courses

Course	Treatment Group	Sex		Grade Level				Post Graduate	Totals
		Boys	Girls	9	10	11	12		
Concepts of Mathematics I	TV Only	74	35	–	21	30	57	1	109
	Seminars	11	6	–	5	5	7	–	17
	Visits	53	18	–	16	12	43	–	71
	Seminars and Visits	23	14	–	7	10	20	–	37
	Totals	161	73	–	49	57	127	1	234
Concepts of Mathematics II	TV Only	53	17	1	7	16	45	1	70
	Seminars	28	10	–	1	2	35	–	38
	Visits	48	41	–	2	18	67	2	89
	Seminars and Visits	12	4	–	1	3	11	1	16
	Totals	141	72	1	11	39	158	4	213
Science for the Space Age I	TV Only	46	12	1	15	19	23	–	58
	Seminars	14	15	–	9	11	9	–	29
	Visits	54	32	–	18	31	37	–	86
	Seminars and Visits	23	3	–	2	9	14	1	26
	Totals	137	62	1	44	70	83	1	199
Science for the Space Age II	TV Only	9	2	–	2	1	7	1	11
	Seminars	13	2	–	6	6	3	–	15
	Visits	26	9	–	5	10	20	–	35
	Seminars and Visits	11	3	–	–	7	7	–	14
	Totals	59	16	–	13	24	37	1	75

Table 2 shows that generally more than twice as many boys were enrolled in the program than girls. The largest enrollments were in grade 12. Seniors comprised 54 per cent of the enrollment in Concepts of Mathematics I, 74 per cent of Concepts of Mathematics II, 42 per cent of Science for the Space Age I, and 49 per cent of Science for the Space Age II. Only one grade 9 boy enrolled, and the percentage of grade 10 pupils was small.

The variations in size of the four treatment groups were dependent chiefly upon the availability of assistant teachers for providing supplementary service.

Experimental Design

The students were divided by schools into four groups. One group had only the televised instruction plus the resources of their own schools. A second group had no visits, but the students attended Saturday seminars once a month with students from nearby schools. A third group had the services of assistant teachers who visited the schools bi-weekly to provide face-to-face help to the students. A fourth group had both of these services.

The Test Advisory Committee considered at length the desirability of forming a control group of students in schools which were outside the viewing area or which declined to permit their students to take the televised courses. Upon the recommendation of Dr. Kalmer Stordahl of the U. S. Office of Education, the Committee concluded that such a control group was not necessary for statistical purposes and that the group which had neither school visits nor seminars could serve as the control group.

In September 1959 the participating schools were located on a map. When it was observed that they were fairly evenly distributed along a 400-mile diagonal extending from Kittery at the southern tip of the state northeasterly to Fort Fairfield, the schools were arranged into geographical clusters. The seminar clusters contained schools so located that students could meet conveniently in one school. The visit clusters contained schools so located that the assistant teachers could visit one school in the morning and another in the afternoon. When choices were possible, however, schools were distributed among the four treatment groups as evenly as possible in terms of enrollment and socio-economic environment. It was felt that the possible bias in the selection for treatment would be compensated for by the covariance analyses of the data.

All of the participating students in a school were assigned to the same treatment group. This decision was reached because it was believed that students who attended seminars or who were assisted by visiting teachers would frequently be likely to share the additional knowledge with their classmates.

School visitation schedules were arranged in advance to suit insofar as possible the convenience of local school personnel. The most common time for a visit was immediately after the close of school. Frequently visits were made during the noon luncheon hour and during activity periods. In many schools pupils were excused from regular classes in order to work with the visiting teacher.

The length of school visits varied from thirty minutes to more than three hours. The average visit was for approximately one hour. The length of the visitation depended principally upon the needs of the students.

In the visitations the assistant teachers helped the pupils to resolve questions which had arisen since the last meeting, and did some supplementary teaching. They reviewed the assignment sheets both as a check on the amount of work accomplished and as a means of ensuring understanding of the material. They conducted reviews for students who had missed televised lessons because of illness or television transmission and reception difficulties. Reviews also were conducted in preparation for the unit tests. The teachers consciously sought to develop appreciation and liking for mathematics and science, and pointed out opportunities for careers in these fields.

Seminars were monthly meetings of an assistant teacher with students from several schools. The meetings were held in a school located within short driving distance from the other participating schools.

During the first year all seminars were scheduled on Saturdays from 9:00 A.M. until 12:00 M. During this year it became apparent that some schools would prefer to have the seminars on another day. In 1960-61 schools within a seminar cluster were given opportunity to choose collectively, and during this year approximately half of the seminars were changed from Saturday to Wednesday or Thursday afternoon.

In 1959-60 there were five seminar centers for Concepts of Mathematics, with a total initial enrollment of 95 pupils. During the year 20 pupils ceased to attend. The mean initial attendance was 19.0 and the mean final attendance was 15. (Table 3.)

In 1960-61 there were six seminar centers for Concepts of Mathematics, with an initial total enrollment of 85. By May of 1961, seventy-one students were still in regular attendance. The initial average attendance was 14.2, the final, 11.8 pupils.

In 1959-60 four seminar centers were organized for Science for the Space Age. The September total enrollment was 127, and the enrollment at the end of the year was 74. The initial average membership of 31.8 decreased to 18.5 by the following spring.

In 1960-61 there also were four seminar centers for the Science for the Space Age course, with a combined enrollment of 51 pupils. The total final enrollment was 27. The mean membership at the beginning of the year was 12.5, at the end of the year, 6.8.

The responsibility for pupil attendance at the seminars rested with the coordinator in each school. No project funds were used for transportation of pupils or teachers.

The teacher coordinators were cordially invited to attend the seminars, but few did so.

In the seminars the assistant television teachers conducted the same program of services as they did during school visitations. The chief difference lay in the adaptations made necessary by the larger numbers of pupils and the need for maintenance of discipline. Also, course material was covered much more extensively and thoroughly.

TABLE 3
Enrollment in Seminars

Concepts of Mathematics
1959 - 1960

Seminar Center	Student Enrollment Initial	Final
Thornton Academy	39	30
Presque Isle	11	10
Auburn	12	10
Augusta	20	15
Farmington	13	10
Total Enrollment	95	75
Mean Enrollment	19.0	15.0

Science for the Space Age
1959 - 1960

Seminar Center	Student Enrollment Initial	Final
Thomaston	48	33
Dexter	6	6
Waterville	51	21
Bangor	22	14
Total Enrollment	127	74
Mean Enrollment	31.8	18.5

1960 - 1961

Seminar Center	Student Enrollment Initial	Final
Presque Isle	13	9
Thomaston	22	19
Mattawamkeag	10	10
Oxford	9	7
Freeport	17	15
Wiscasset	14	11
Total Enrollment	85	71
Mean Enrollment	14.2	11.8

1960 - 1961

Seminar Center	Student Enrollment Initial	Final
Bangor	16	8
Hollis	12	6
Fairfield	14	8
Farmington	9	5
Total Enrollment	51	27
Mean Enrollment	12.5	6.8

Evaluation Instruments

The evaluation instruments used in this study were those selected by the Test Advisory Committee at its meeting in Augusta, Maine, on July 31 and August 1, 1959.

The ***School and College Ability Test,*** the ***Sequential Test of Educational Progress in Mathematics and Science,*** and the ***Facts About Science Test*** were administered to all students at the beginning and at the end of each school year, with the single exception that some Concepts of Mathematics students were not permitted by their schools to take the ***Facts About Science*** test because of the time required to administer it. ***Sizing Up Your School Subjects*** was administered in the spring of each year. A ***Student Attitude Questionnaire*** and a ***Biographical Aspiration Inventory*** were administered late in the second year. Unit achievement tests were prepared by the project staff approximately once a month, with an end-of-course test at the end of each year in both subjects.

During the second year of Concepts of Mathematics, the television teacher suggested that the unit achievement tests be administered during the half-hour allotted for the televised course. To satisfy adult viewers and the students in schools which still preferred to administer the tests at a different time, recreational mathematics not essential to the course was presented at this time.

All of the tests were provided at no cost to participating schools. They were administered by local school personnel and were returned to the project staff for correction. Copies of the test results were then sent to each school.

A copy of the ***Student Attitude Questionnaire*** is included in Appendix B.

School and College Ability Tests (SCAT)

These tests were designed to aid in estimating the capacity of a student to undertake academic work at any of several levels of schooling. The two kinds of school-related abilities measured are verbal and quantitative. Specifically, the verbal subtests measure a student's ability to understand sentences and to give the meanings of words. The quantitative subtests measure an individual's ability to perform operations with numbers and to solve mathematics problems stated in words.

Among other things, the publishers state that one of the ways in which results can be used is for " . . . conducting educational research where an independent measure of abilities present in a group is a necessary experimental 'control.' " In this study the converted test scores, based on alternate forms of the Level I test, are used as standardized control variables.

Sequential Tests of Educational Progress (STEP)

The Sequential Tests of Educational Progress are a series of achievement tests which measure critical skills in application of learning in seven major fields of academic work. Focus is placed on skill in solving new problems on the basis of information learned, rather than on ability to handle only " lesson material."

In this study, measurement was obtained in two of the seven major academic areas — mathematics and science. As in the case of SCAT, alternate forms of the Level I test were administered at the beginning and end of each year.

The purpose of the STEP Mathematics is to measure the extent to which the important objectives of mathematics in general education have been achieved. The test measures the broad mathematical concepts in number and operation, symbolism, measurement, and geometry, function and relation, deduction and inference, and probability and statistics.

The STEP Science was designed to measure a student's ability to use scientific knowledge to solve problems, and to measure the application of scientific knowledge to familiar and unfamiliar situations. Understandings of basic concepts in each of several major science areas are tested in combination with skills essential to application and critical thinking.

STEP do not measure specifically growth in the particular areas taught in the experimental televised courses. Nevertheless they were considered to be valuable measures of the effect of the program in stimulating growth in subject matter and in skills considered important in these two areas.

The Facts About Science Test (FAS)

This is a relatively new instrument. Norms and validation data are not yet available. In this study the test, available in only one form, was administered at the beginning and end of each year.

The purpose of FAS is to measure the understanding examinees have of " the role science plays in contemporary society " (Scale 1), and of " the way scientists as a group differ from people in general " (Scale 2). It differs from other achievement tests in that it attempts to indicate " . . . how the student perceives the *implications* of these (science) facts and techniques for society and for his life." 1/

Sizing Up Your School Subjects (SUYSS)

This questionnaire, administered in the spring of both years, is essentially a research instrument intended for use in experiments where television is being used at the secondary-school level as an instructional technique. The instrument is designed to measure the reactions of students on ten aspects of instruction, the fundamental approach being one that requires the student to compare each course he is taking—including the television course—with every other course he is taking.

The ten comparison exercises, expressed as questions, are:

I. How do you like the subjects you are now studying?
II. How much time do you actually spend on the subjects you are now studying—both at school and at home?
III. How often do you have a chance to ask the teacher questions in your different subjects?
IV. How often do your subjects (classwork and homework) keep you from taking part in outside activities you would rather do?
V. How easy to learn are the subjects you are now studying?
VI. To what extent do you consider your different subjects useless to you?
VII. To what extent is the teaching in your different subjects clear and understandable?
VIII. How much serious discussion among students goes on in class in your different subjects?
IX. How much does your mind wander in your different subjects?
X. How much do you learn from your different subjects?

The SCAT, STEP, SUYSS, and FAS tests were all obtained from the Cooperative Test Division, Educational Testing Service, Princeton, New Jersey.

1/ Stice, Glen, *Manual for the FACTS ABOUT SCIENCE TEST*. Princeton, N. J.: Educational Testing Service, 1958, pp. 1 and 2.

Biographical Aspiration Inventory

Using several inventories developed elsewhere, the staff members built a *Biographical Aspiration Inventory* consisting of 39 multiple choice questions. The first 8 are concerned with factors in the environment which seem likely to influence development of educational plans. The last 31 pertain to the educational, vocational, and personal preferences and ambitions of the students.

Two copies of this inventory were given to each student in April 1961, with instructions to complete one form in terms of his present attitudes, and the other in accordance with what he remembered to be his attitudes when he enrolled in the televised courses the preceding September. This was a late effort to obtain data concerning possible changes in educational and vocational aspirations as a result of the televised courses.

Course Attitude Questionnaire

This instrument was developed by project staff members from several similar questionnaires used in educational television research projects and loaned by Dr. Henry Dyer of Educational Testing Service. Multiple choice questions were prepared in six categories — general evaluation, difficulty of course, attention, application, independent additional work, and mechanical problems. Each of the 36 questions had five possible answers.

As was true of the *Biographical Aspiration Inventory,* the preparation of this questionnaire represented a late effort to gather additional data. Pupils were asked in April 1961 to complete one copy from the standpoint of their attitudes toward the course at that time, and to complete a second copy in accordance with their memory of their attitudes early the preceding fall.

Observation by Visiting Teachers

Each of the visiting teachers maintained logs in which were recorded observations of pupil conduct which seemed to be significant. These logs have been used in writing Chapters IV, V, and VI.

Basic Assumptions

Five potential variables which conceivably might affect the results sought were recognized early in the study. No evidence was observed of biasing effects, so these assumptions were made:

1. Schools which participated in the experiment are fairly representative of all secondary schools in the state.
2. Difficulties in obtaining a clear television picture and uninterrupted reception were fairly well equated equally among all four treatment groups of schools.
3. Differences in student behavior because of unsupervised television classes and differences in student attitudes because of variations in school atmosphere and spirit were equated fairly equally among all four treatment groups of schools.
4. The alternate forms of standardized tests used in this study are sufficiently equated so that a converted score on one form is equivalent to a converted score on the other form.
5. Pupils enrolled in the course for an entire year had similar attendance records among the treatment groups.

CHAPTER IV. EVALUATION OF STUDENT ACHIEVEMENT AND STUDENT ATTITUDES

The comparative studies of student achievement and student attitudes may be summarized most conveniently by testing six hypotheses.

FIRST HYPOTHESIS

A teacher can present by television to able students a full-year course that will affect the students desirably.

This hypothesis is difficult to test objectively. To obtain evidence concerning its validity, several measures were employed:

1. Estimates of the value of the content of the televised courses by members of the subject-matter advisory committee, by the television teachers, by principals, and by students
2. Review of analyses of item difficulty for the staff-constructed tests
3. Examination of the means of unit and final achievement test scores
4. Analyses of mean gain during the school year in performance in related standardized tests.

Advisory Committee Opinion

In order to evaluate the content of the courses, the members of the subject-matter advisory committees were asked to state their opinions concerning the value to the students enrolled in both courses. The following excerpts are quoted from their letters.

Mathematics Advisory Committee

> " While I was not in a position to observe the teaching very frequently and my coordinator is not now available to consult, we have had occasion to review the TV course together on many occasions and the comments to be made indicate his feelings as well as my own. I have also, of course, talked with each of the students involved in the course each year, and their reactions are likewise involved in the general reactions I have to offer.
>
> " Each year we found the course to be very much worth the time and effort involved in scheduling and the students felt it was equally well worth while. It seemed to provide an additional challenge for students to do more research. It supplemented work being done in regular classes, which had to be limited. It tended to encourage students to seek the information needed rather than to ask for it. We had senior students taking the course in 1959-60 (and they probably got more out of it) while underclassmen were involved in 1960-61. We hope something similar will again be available for our superior students."
>
> —John W. Abbott, Principal
> Old Town High School

> " In traveling about the state I have been afforded some excellent opportunities to discuss the mathematics phase of the Nine O'Clock Scholar Program with teachers and participating students.
>
> " A general composite of the remarks I have heard, combined with my own knowledge of material included in the program, implies that the students had subject matter made available to them which they would not otherwise have been exposed to.
>
> " The level of instruction was high and the overall benefits derived by the students, as well as the observing teachers, were very broad.
>
> " Although it is impossible to measure the ultimate value of a project of this nature, I am sure that there will be many long-range gains in addition to those which are evident to us now."
>
> —Clarence W. Bennett, Mathematics Supervisor
> State Department of Education, Augusta

> " It is a little hard for me to answer your question as we had no one in our school viewing ' Concepts of Mathematics ' either in 1959-60 or 1960-61, nor was I able to see more than a couple of broadcasts myself.
>
> " From comments I have heard through other teachers, it seems, however, that it accomplished its purpose of bringing newer ideas in math to some of those schools that would not be able to offer it themselves. Undoubtedly the students in those schools who viewed the program found it of great value."
>
> —Gordon B. Smith, Head, Mathematics Dept.
> Bangor Senior High School

" My comment on both years of the course would be that it is filling a definite gap in the offerings of many schools. The choice of subject matter is good—it does not cover what is apt to be taught in most schools. Another favorable reaction that I have comes from my experience in teaching in the National Science Foundation Program. Most teachers need help in teaching the ' new ' topics and approach to high school mathematics and the TV program does just this for them.

" I have not had a chance to sit down with either a planning group or an evaluation group in this project—nor have I had the experience of following it through with a group of students. Until I could do one of these things, I would not feel justified in suggesting additions or deletions."

—Dr. Lucille P. Zukowski
Associate Professor of Mathematics
Colby College, Waterville

" To the extent that I have been free to do so, I have followed with great interest what has been done in the Nine O'Clock Scholar Program.

" In my opinion, the script was well organized, and the presentations were excellent.

" I believe everyone agrees that it is important to follow through on the effort that has gone into this program. Coupled with a careful checking on the extent of pupil involvement and on the quality of work done by these pupils who were continually involved, the program is certain to be a measurable help to education in this state."

—Dr. Reinhard L. Korgen
Professor of Mathematics
Bowdoin College, Brunswick

" I did not miss a single broadcast of ' Concepts of Mathematics ' last year. I therefore had an excellent opportunity to make fairly objective observations of my class and their reactions to the program.

" In my opinion the following seemed to be significant:

" 1. Subject matter presented was excellent and comprehensive.

" 2. There seemed to be a definite lack of interest by most pupils. The program would have much greater value if the pupils could be inspired to learn.

" 3. It would seem that a portion of each presentation should be preceded by an attempt by a specialist (psychologist) to improve the self-motivation of each student and make the program more dynamic."

—Paul R. Kelley
Superintendent of Schools
Milford

" The material in mathematics covered by the 1959-60 Educational TV course, Nine O'Clock Scholar, gave the high school students in Maine an opportunity to see necessary and fundamental ideas with their use which will take another five years to reach the individual teacher and be incorporated in the general curriculum.

" So many of the present teachers in small schools lack any preparation or have insufficient preparation to teach mathematics that students attending these schools could not be updated on basic ideas in any other way immediately. Course material in trigonometry, statistical inference, finite sets and symbolic logic has greatly broadened the background of students.

" The 1960-61 course presented ideas of groups, rings, matrix algebra and linear programming which were used to show applications of mathematics to psychology, economics, and other social studies. Too many students, teachers and lay people think of mathematics only as a servant for engineering and allied technological fields. These are branches of mathematics that are never taught in small high schools.

" These two years presented an excellent opportunity for strengthening the mathematical preparation of high school students."

—Albert G. Wooton, Associate Professor
of Mathematics, University of Maine, Orono

"My opinion is that the Nine O'Clock Scholar program has been of high value to many Maine high school students. Those students who are preparing for college have had the chance to get an enriched preparation. Colleges are in sympathy with all efforts to bring certain of the more traditional material, as trigonometry, within reach of all high school students as well as to broaden backgrounds by introducing modern approaches to mathematics."

—Dr. Spofford H. Kimball, Head
Dept. of Mathematics and Astronomy
University of Maine, Orono

Science Advisory Committee

"On account of scheduling difficulties and because so many of our seniors had taken the TV course 'Space Age Science' as juniors, we had only one girl enrolled this past year—and she was taking it the second time because of her interest in it.

"Most of our students during the past two years have appreciated the fact that the topics not usually taken up in the regular classroom were investigated, and pieces of equipment and demonstrations which they would not see otherwise were used.

"I want to mention also the skillful presentation of the TV teachers and the outside reading of topics beyond the scope of the average high school science student."

—Gardner C. Pope, Principal (and formerly
Head of Science Department)
Falmouth High School

"It is my opinion that the various states should offer this kind of educational TV. Students participating have derived great value from it according to those I have spoken with personally. There will continue to be debate as to just what material should be presented and what pedagogical techniques are most effective, so I recommend that future programs enlist thoroughly competent master teachers whose own methods and backgrounds will set tone and pace. For bright young minds contemplating science, variety is far preferable to standardization. In this respect the two-year effort in Maine has also done well. I hope substantial growth follows this pioneering effort."

—Austin S. Kibbee, Jr., Science Teacher
Leavitt Institute, Turner Center

"Apart from the value derived from comparing performances of the different instructional groups established in the two TV science courses, I am certain there were substantial gains made by the individual students themselves. These advances can be summarized as follows:

"1. All course members were forced to learn (or to re-enforce) the skills of independent study. Many students for the first time learned how to take some responsibilities for their own achievement.

"2. All members surely advanced in their understanding of science. Many, if not most, of these gains would have been denied them had there been no TV courses. For the most part, the content of both courses was both fresh and timely.

"3. For the first time, some students learned science under the guidance of experienced, well-qualified teachers.

"4. Most students doubtlessly learned how to use TV as a medium of instruction. The skills they developed of listening, thinking, and observing should serve them well in viewing other educational programs over TV.

"5. All members at some points in the courses were forced to reach high in order to grasp the concepts presented. Probably for the first time many students were confronted with science content and learning activity suited to their high abilities."

—Dr. George T. Davis
Professor of Education
University of Maine, Orono

" I have observed the Educational Television programs in Science both nationally and at the state level. The students have had an opportunity to see an outstanding teacher perform, a teacher who was able to devote 100 per cent of his time to the presentation of a single course. However, a follow-up is necessary as exemplified by Maine's Nine O'Clock Scholar Program. Textbook readings, problem assignments, opportunities for discussion as well as examinations must be given at the local level. The combination of a single masterly exposition with reaction demanded of the individual pupil holds great promise as a new educational procedure."

—Dr. Noel C. Little
Josiah Little Professor of Natural Science
Bowdoin College, Brunswick

" The number of students enrolled and tested in Space Age Science was too limited to assess any valid far-reaching conclusions from the test scores.

" The score frequencies reflect a good to excellent performance, which would indicate high quality of mastery.

" It was my pleasure to view the Nine O'Clock Scholar Science program on an average of once a week over the two-year period, and I must say Mr. Whitten and Mr. Robinson both did a superb job with the complex subject matter involved.

" Let us hope that means may be found to continue this fine program."

—Timothy J. O'Connor, Professor of Science
Saint Joseph's College, North Windham

" My top student was enrolled in the 1959-60 Space Age Science. I was able to follow it completely with him. He found it stimulating and rewarding. My regret was that more students could not take advantage of it due to scheduling. Our Biology II class made use of parts where biology was covered.

" Last year, 1960-61, scheduling made it impossible for me to view the course except for vacation periods. What I saw then was excellent. My feeling and impression has been that this year's program was even better than last year's."

—Paul W. Legge, Science Teacher
Maine Central Institute, Pittsfield

" In my opinion the Space Age Science for 1959-60 and 1960-61 has proved highly successful for both pupils and teachers.

" The content and presentation have been thorough and practical, showing the result of many hours of preparation and planning involved. More pupils are consequently better prepared for advanced work in science, for better grades in college entrance examinations, and for an appreciation of the place of science in their lives.

" All in all, I consider the program a valuable contribution to all the school systems taking advantage of it."

—Sister M. Euphrasia
Saint Joseph's College, North Windham

" The Nine O'Clock Scholar Program has been a real help to students in our small high schools. Students in these schools usually have had inferior instructors, and a scarcity of science equipment. Although there is no substitute for actually using the equipment in a laboratory, certainly the viewing of the equipment as it is being used by an experienced teacher is extremely valuable."

—Emery S. Dunfee, Science Supervisor
State Department of Education, Augusta

These letters generally do not indicate that the writers realized that the purpose of their writing was to indicate an adequate level of achievement of subject matter and of stimulated interest. The letter of Professor Timothy J. O'Connor does indicate that type of comment. Other comments do at least imply general approval.

Project Staff Opinion

After the completion of the second year of the program, the assistant teachers were asked to estimate the extent to which they believed students were really challenged to extend themselves by the televised courses and the extent to which they believed students really learned mathematics and/or science through the televised programs. The attitudes of these teachers were, of course, inevitably influenced by the fact that they had helped to build the courses. However, through school visitation and seminars they had had more opportunity to observe the participating students and to form judgments concerning pupil progress than did any other persons.

The four following excerpts are typical of the evaluations made by the assistant teachers.

Concepts of Mathematics I

"In reply to your request for a personal, subjective evaluation of the Nine O'Clock Scholar program:

"(1) I feel that the students who participated in the TV program were challenged to extend themselves. The material presented was of a relatively advanced nature for high school students. The student found that he was competing with a state-wide group of students, all of whom were as capable as he.

"(2) It is my feeling, also, that the best high school mathematics program in the state was presented by the television group. The program, with its emphasis on concepts, ideas, and structures, encouraged students to do their own thinking. To many students, the TV program was the only respectable mathematics course they took during their high school years."

Concepts of Mathematics II

"The following is my statement concerning the TV program: all students were challenged. Even students from schools with better than average math programs. About three-fourths of the students met the challenge by passing the course. Those that were motivated to study and had the ability learned a great deal of both the conceptual and manipulative aspects of mathematics."

Science for the Space Age I

"I feel certain that many students did profit considerably from the part of the Nine O'Clock Scholar experiment with which I was associated. The degree to which students profited depended on a number of factors. What I feel to be the most important of these are the following:

"1. Students should have a sincere desire to learn science before participating in the program. I do not think a desire to learn can be fostered via TV.

"2. The student should be able and ambitious.

"3. The student should have a favorable attitude towards the medium of presentation.

"Students who possessed favorable traits such as those mentioned above learned a great deal of science which they would probably not been exposed to in their own high school. I feel that the majority of the participating students gained a great deal from participating in the program. For some students who lacked the above traits and probably many other favorable ones the programs were of little value except for diversion and incidental learning."

Science for the Space Age II

"Over half the students with whom I had contact in 'Science for the Space Age II' gave the impression that the TV course challenged them to 'something more' than watching the actual programming. This 'something more' included:

"(1) reading of books of scientific nature,

"(2) studying of further technical aspects of course material,

"(3) developing of better study habits,

"(4) feeling of accomplishment from independent study.

"In my opinion the science learned through the TV program was equivalent to a lecture demonstration course over material more advanced than the usual high school sciences. If 'Science for the Space Age II' had been given in such a classroom situation, I doubt that the 'something more' results would have been obtained as through the TV presentation."

One person who observed the program closely was Mr. Chester E. Willette, State Supervisor of Secondary Education. His evaluation is as follows:

"Briefly, I believe:

"1. The major value of the Space Age Science program was to our smaller schools. It presented a much more vigorous approach to science than usually is found in the small school and was much broader in scope than the usual chemistry and physics program in these schools. In addition, the instructors were able to present demonstrations that could not be done in the limited facilities of most of our smallest schools.

"2. The program provided for the larger schools an opportunity to enrich their science program, for the TV science program extended and expanded many of the concepts already taught in the regular high school program and introduced many others. For these schools the TV program should not replace chemistry and physics but be used for enrichment.

"3. Review of the test scores indicated to me the need for a teacher to work closely with students to encourage and motivate them in spending ample time for the preparation of assignments and to assist students in understanding the material presented.

"4. Probably the greatest criticism of the program would be the haste in which the program had to be developed and the limited number of persons available to carry it out."

It would appear that this is additional evidence that the televised courses did affect the students desirably.

Poll of Graduates

Early in December, 1960, the Concepts of Mathematics teachers sent a brief questionnaire to the 127 students who had completed the Concepts of Mathematics I course as members of grade 12. Ninety-two usable responses were received in late December and in January. The results of this poll may be summarized as follows:

86 of the 92 students said they were attending college.

74 were enrolled in college courses in mathematics.

69 stated that they were enrolled in college mathematics courses and that the mathematics they had learned in Concepts of Mathematics was a valuable aid in their college work.

9 indicated that they were not taking college mathematics, but that the mathematics they had learned in Concepts of Mathematics was valuable in other college courses.

5 stated that they were enrolled in college mathematics courses and the mathematics they had learned in the televised courses was not valuable to them in their college work.

3 indicated that they were not enrolled in mathematics courses and their Concepts of Mathematics work was not valuable to them in their college programs.

Among the comments made by students who were enrolled in mathematics courses in college and who indicated that they did not find the mathematics they had learned in Concepts of Mathematics helpful in their college work were the following:

> "At the beginning of the year I was very interested. After the first month and a half the program became monotonous to me. The instructor lingered on the same subject or problems so long that I became bored."
>
> "I do not believe that the coordination between the teacher in charge, and the headquarters was complete enough to allow the students to accomplish enough from this course."
>
> "I have not found it valuable yet, but I know of several students who are taking a similar course in college and have voiced approval of last year's course."
>
> "I believe most college freshmen take a course in analytic geometry or calculus and I do not find that statistics, probabilities or logic have so far helped me. Nor have I found that the different number systems have helped. I think a course of more related material could be devised to help students in college mathematics."
>
> "I'd like to explain that the reason Concepts of Math is of no help to me this year is that I am attending business college for a year, after which I will attend the University of Maine where I plan to major in math. I'm sure that what I learned from Concepts of Math will be of value later."

Typical of the comments made by students who were enrolled in mathematics courses in college and who indicated that they found the mathematics they had learned the preceding year in Concepts of Mathematics valuable this year, are the following comments. They were selected randomly from the responses.

> UNIVERSITY OF MAINE—"I feel that the pursuit of number theory, math induction, number systems, and especially logic, as you presented it last year, is an invaluable aid to the senior bound for college. I have found that many subjects which I had in high school have been somewhat inadequate preparation for college. Your

program was an exception. I might even say that it prepares the student somewhat for the psychological change, in that it is impersonal (as classroom teaching in high school cannot be) yet interested in the progress of any individual."

UNIVERSITY OF NEW HAMPSHIRE—"I think this program introduced me to many concepts in mathematics, though I didn't understand some points completely, as I see them again in college they are brought back and understood with much more simplicity than if I hadn't seen them."

HOLY CROSS COLLEGE—"Last year when I took the math course I didn't realize just how useful it would be to me in my college math. I know if I had realized this I would have gotten a great deal more out of it. As it was I received many basic concepts last year that have been useful to me this year."

BOWDOIN COLLEGE—"Introduction to Modern Mathematics at Bowdoin is the same as I had over the television except that it also includes trigonometry, analytic geometry, and calculus with polynomials. It (the televised course) really helped me get my studies in order because I had had most of the math we had at first and so didn't have to spend a large amount of time on it during the difficult period of adjustment. Many of the things I learned are still helping me now that we are taking up new things. It seems to come easier to me now."

ROBERTS WESLEYAN COLLEGE—"I think it is a good course. I believe that any student that plans to go to college and do something with their life should have it. As I look back, I can't think of anything that wasn't new to me. Sometimes it was hard to keep up with Mr. Brown, but when seminar came up our problems were usually ironed out.

"I think it has broadened my mathematical education. Whenever anyone talks about base or modulus arithmetic or anything we studied I can carry on an intelligent conversation."

NORTHEASTERN UNIVERSITY—"The course was very educational. It not only increased one's scope of the field of mathematics, but also taught one how to be more independent in thinking through the solution of a problem without the aid of a teacher. I hope the course will be continued in the future.

"The course helped me to now grasp more quickly the abstract concepts presented in math and physics."

The following letter was received in late November, 1961, by a Maine superintendent of schools. It was written by a student at Massachusetts Institute of Technology who had been enrolled in Science for the Space Age I and Concepts of Mathematics II.

"Mr. Roland B. Andrews
Superintendent, School Administrative District #1
Presque Isle High School
Presque Isle, Maine

"Dear Sir:

"I was informed that you would be interested in hearing from the students who have had the television courses in the past two years, and especially their opinions of its value to them. I consider myself fortunate in having been able to take one course in each year. The first year that they were offered I was enrolled in 'Science for the Space Age,' and the following year, 'Concepts of Mathematics.' Both of these courses were very valuable in my estimation.

"First I shall deal with the science course. This course has helped my preparation for Massachusetts Institute of Technology immensely. Because the program of the course consisted of studies of different fields of science on a college level, it gave a very good background of scientific material which has proved applicable to continued study. The unit which benefited me the most was the unit on astronomy which I shall use as an example of the typical value of the course. This was a subject which I had never studied in school and may not in the future although I found it very interesting. This section of the course gave me an introduction to college astronomy and led me to read a college text during the summer. Although I have now forgotten much of what I read, I am still familiar with the subject, and it would take very little reviewing to bring it back to mind. My roommate here at MIT is taking an astronomy course, and thanks to the television course can recall most of what he is studying. One of the primary purposes and values of the television science course was that it provided a stu-

> dent the opportunity to become aware of the many scientific fields open to him which were not taught in many high schools, and it gave him an introduction which perhaps would encourage him to do further reading and studying. One other advantage of the television course, especially in science, was the opportunity to see experiments which could not be done in the local schools.
>
> " There is also one definite advantage to both science and math on television. This is the practice obtained in taking notes and listening to lectures which is invaluable to a student going on to college.
>
> " The mathematics course was also a good preparation for the work here, especially since a large number of the other students had already covered the material taught in ' Concepts of Mathematics ' course. There are many small examples which I could give of the value of this course, but I shall only list a few here. The study of functions, which we studied, was done here at MIT in the first week of the calculus course. The study of sets and their notation has also been covered. The largest unit of the math course, matrix algebra, will be dealt with in second term calculus.
>
> " I feel that the television courses should be continued. They were a great help to me, and I think that they can help many more students. These courses are well worth the effort and expenditures necessary if they are combined with proper coordination in the local schools. I cannot emphasize enough the value of these two courses and the help they have been to me.
>
> Sincerely yours,
> (s) John F. Berry "

From the data obtained by this questionnaire, it would appear reasonable to conclude that in the opinions of the participating students who had an opportunity to attend college, the Concepts of Mathematics I course presented material of a nature and level of difficulty that was definitely helpful in preparing the students for successful experiences with college courses in mathematics. It is interesting to observe the apparently increased appreciation of the value of the televised course by students after they had had some college experience in comparison with the opinions expressed by the students when still in high school, as reported in the testing of Hypothesis 4 in this chapter.

This opinionnaire was designed and distributed by the Concepts of Mathematics II staff. It is to be regretted that a similar follow-up was not organized for all of the four televised courses.

Analyses of Item Difficulty

Because of their length, copies of all staff-constructed unit and final achievement tests and analyses of item difficulty have been duplicated in a supplement to this report. Several copies have been filed with the United States Office of Education. Examination of these tests indicates that the tests were reasonably well constructed.

Means of Unit and Final Achievement Test Scores

Figures 2 and 3 report the actual mean percentage scores of Concepts of Mathematics students on the staff-constructed achievement tests. Figure 4 shows the average raw scores earned by the Science for the Space Age pupils.

From an examination of these graphs it would appear that the students generally performed satisfactorily in these tests.

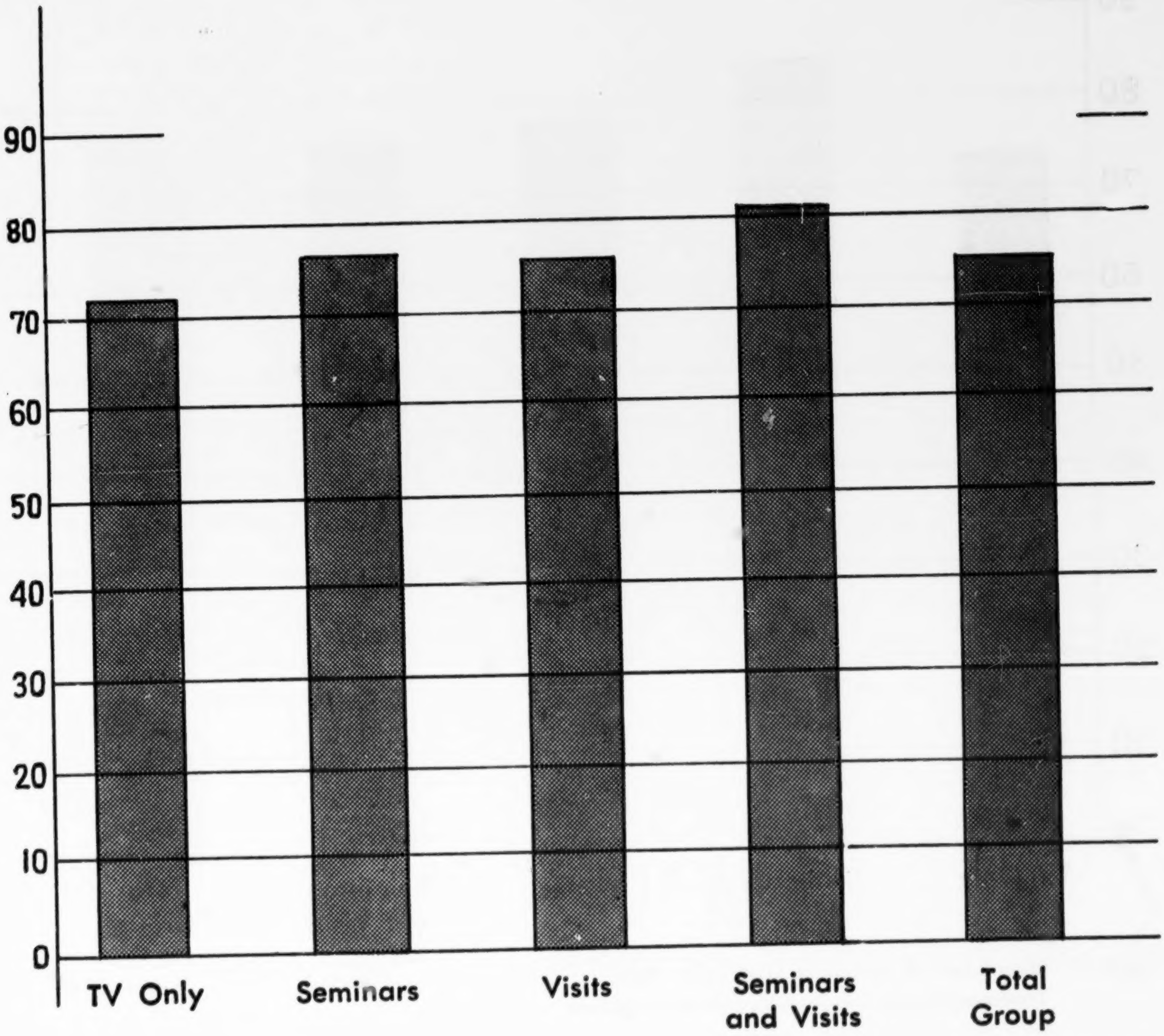

Figure 2: Mean Scores of Concepts of Mathematics Students in Staff-Constructed End-of-Course Achievement Tests by Treatment Groups and for Entire Group, 1959-1960.

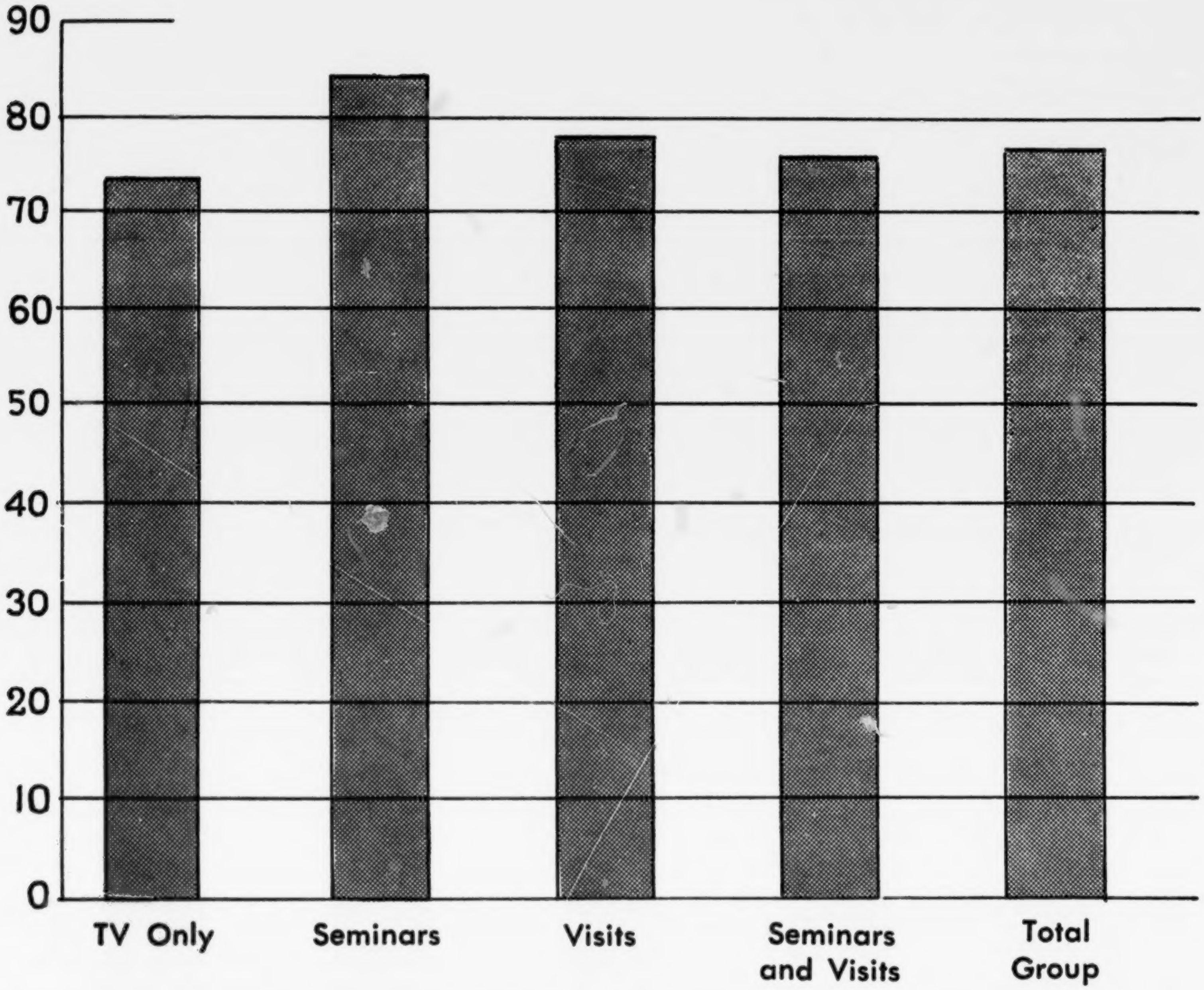

Figure 3: Mean Scores of Concept of Mathematics Students in Staff-Constructed End-of-Course Achievement Tests by Treatment Groups and for Entire Group, 1960-1961.

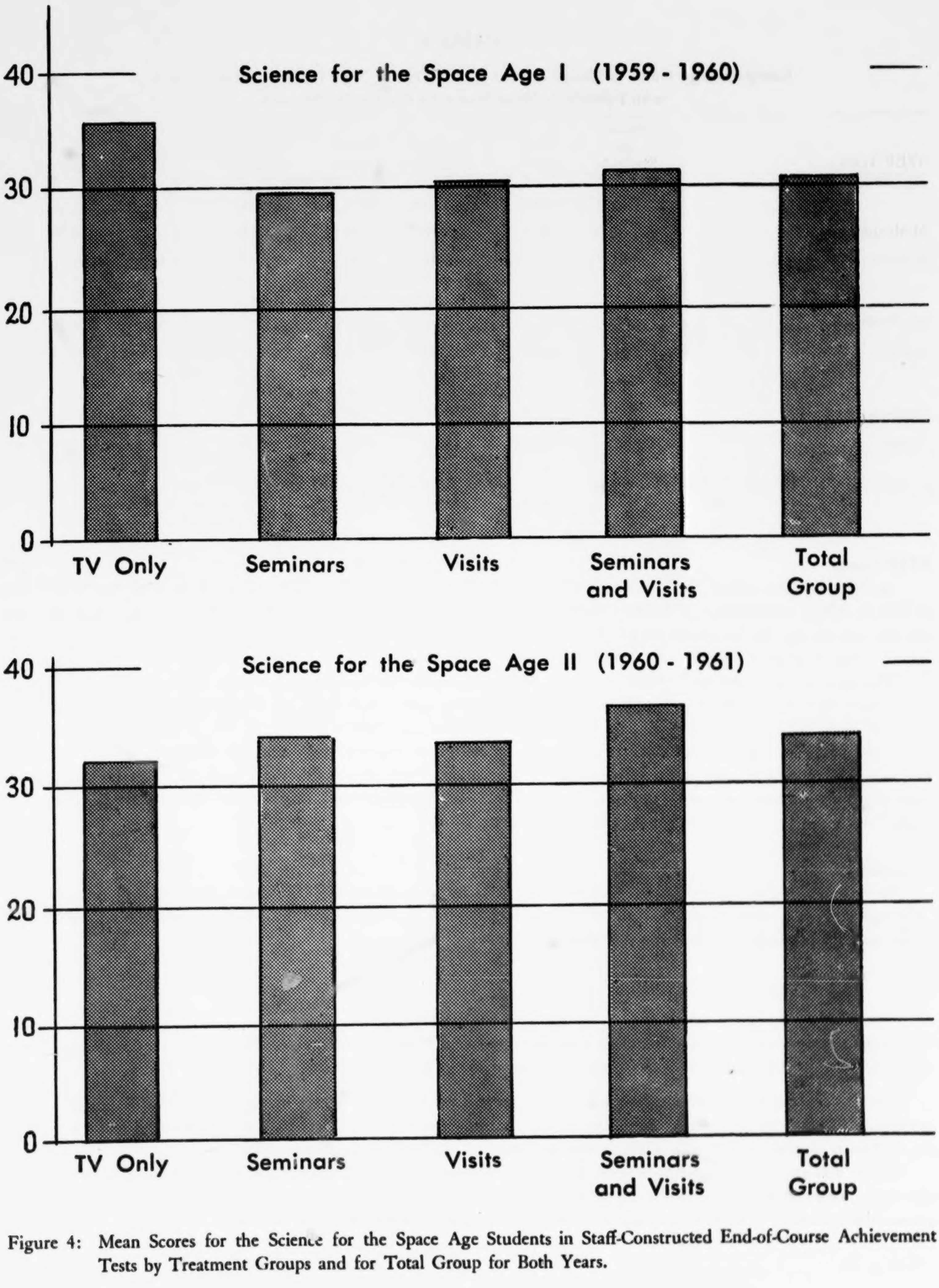

Figure 4: Mean Scores for the Science for the Space Age Students in Staff-Constructed End-of-Course Achievement Tests by Treatment Groups and for Total Group for Both Years.

TABLE 4

Comparison of Gains in Mean Scores in STEP Tests of Nine O'Clock Scholar Students with Publisher's Mean Scores for College Sophomores

STEP Tests	Number of Students	Fall		Spring			
		Mean Score	Standard Deviation	Mean Score	Standard Deviation	Mean Gain	t-ratio
		Educational Testing Service College Sophomore Scores 1/					
Mathematics	146	283.47	16.42	286.12	15.33	2.65	1.0076
Science	146	287.03	13.32	290.55	14.43	3.52	1.5441
		Nine O'Clock Scholar Scores, 1959-1960					
Mathematics	217	294.95	10.84	298.63	10.33	3.68	2.5548*
Science	194	294.53	12.46	302.95	11.31	8.42	4.9239***
		Nine O'Clock Scholar Scores, 1960-1961					
Mathematics	202	294.42	10.48	299.99	8.98	5.59	4.0514***
Science	62	297.83	14.20	300.13	10.61	2.30	.7255

1/ 1958 SCAT-STEP SUPPLEMENT. Princeton, New Jersey: Educational Testing Service, 1958, p. 24.

STEP Scores

In 1958 the Educational Testing Service obtained the cooperation of 77 colleges in administering the STEP and SCAT to college sophomores. 1/ Table 4 shows that the Nine O'Clock Scholar students earned higher scores on both the fall and spring administration of the STEP mathematics and STEP science than did the group of college sophomores. This is additional evidence that the television course students were an able group.

The gains between fall and spring in mean scores achieved by the college sophomores on the STEP mathematics and science were not significant. Significant increases in mean scores were obtained by the Nine O'Clock Scholar students in both STEP in 1959-1960 and in the STEP mathematics in 1960-1961.

Comparison by t-tests of the mean fall scores of the college sophomores with the fall scores of both of the Nine O'Clock Scholar groups, and of the spring scores of the college sophomores with the spring scores of the two experimental groups for both tests show that the Nine O'Clock Scholar scores were in each of the eight instances significantly higher at the one per cent level than the college sophomore scores.

Conclusion

Review of the data reported above indicates that it seems reasonable to conclude that the first hypothesis is valid. Although there was some variation in the effectiveness of the four courses, they all were of high quality, and the students made satisfactory progress in learning the content presented.

SECOND HYPOTHESIS

Variation in the amount of supplementary teaching services provided by teachers competent in the subject presented will produce significant differences in the achievement of the pupils.

The project staff both years consciously sought to present on television subject matter not commonly taught in conventional secondary-school science and mathematics courses. The television teachers also attempted to teach in greater depth than is possible except with select groups and superior teachers in the largest schools.

In the majority of participating schools the science teachers were not familiar with all of the content presented on television. This condition was even more prevalent in mathematics. Also, in only a few cases did local school schedules permit the science or mathematics teachers to view the televised courses with the students.

1/Ibid, p. 24.

Teachers in participating schools were neither encouraged or discouraged from helping the students. However, these teachers realized that the project was an experiment, and many of them refused to help their students, even when they were well qualified to do so, lest they disturb the research pattern.

For these reasons, and because this variable was impossible to control, it is assumed for the purposes of this study that (1) little subject matter assistance was given to participating students by the teachers in their schools, and (2) the amount of assistance did not vary among the four treatment groups.

TABLE 5

Mean Scores of Concepts of Mathematics I Students in Staff-Constructed Achievement Tests by Treatment Group and for Total Group

Treatment Group		Television Only	Seminars	Visits	Seminars and Visits	Total Group	F-ratio
Number of Students		109	17	71	37	234	
Test		Mean Percentage Scores					
End-of-Course Test	Actual	72.156	77.000	76.437	81.378	75.265	
	Adjusted	72.047	75.540	76.345	79.919	–	15.051**
Unit Test – Logics and Sets	Actual	67.303	72.206	73.592	79.702	71.528	
	Adjusted	67.353	70.750	73.388	78.248	–	7.859**
Unit Test – Number Theory	Actual	69.918	77.412	75.634	83.068	74.276	
	Adjusted	69.907	75.549	76.236	81.891	–	1.051
Unit Test – Probability and Statistics	Actual	69.954	73.118	74.366	77.297	72.684	
	Adjusted	69.892	72.142	74.197	76.321	–	.966

**Significant at 1% level.

In testing these data an analysis of covariance was used, so the adjusted means are the estimates for the groups when they are equated by using control variables in the analyses. The control variables are reported in Appendix A.

TABLE 6

Mean Scores of Concepts of Mathematics II Students in Staff-Constructed Achievement Tests by Treatment Group and for Total Group

Treatment Group		Television Only	Seminars	Visits	Seminars and Visits	Total Group	F-ratio
Number of Students		70	38	89	16	213	
Test		Mean Percentage Scores					
End-of Course Test	Actual	73.771	84.026	78.393	76.313	77.723	
	Adjusted	73.224	80.806	79.634	73.092	–	5.323**
Unit Test – Trigonometry	Actual	77.386	84.934	77.623	77.625	78.850	
	Adjusted	76.963	82.229	78.459	74.919	–	4.078**
Unit Test – Matrix Algebra	Actual	79.557	87.039	83.483	83.688	82.843	
	Adjusted	79.429	84.923	84.193	81.571	–	4.566**
Unit Test – Set Theory	Actual	75.643	84.553	81.247	72.250	79.319	
	Adjusted	75.065	82.361	82.271	70.059	–	8.814**

**Significant at 1% level.

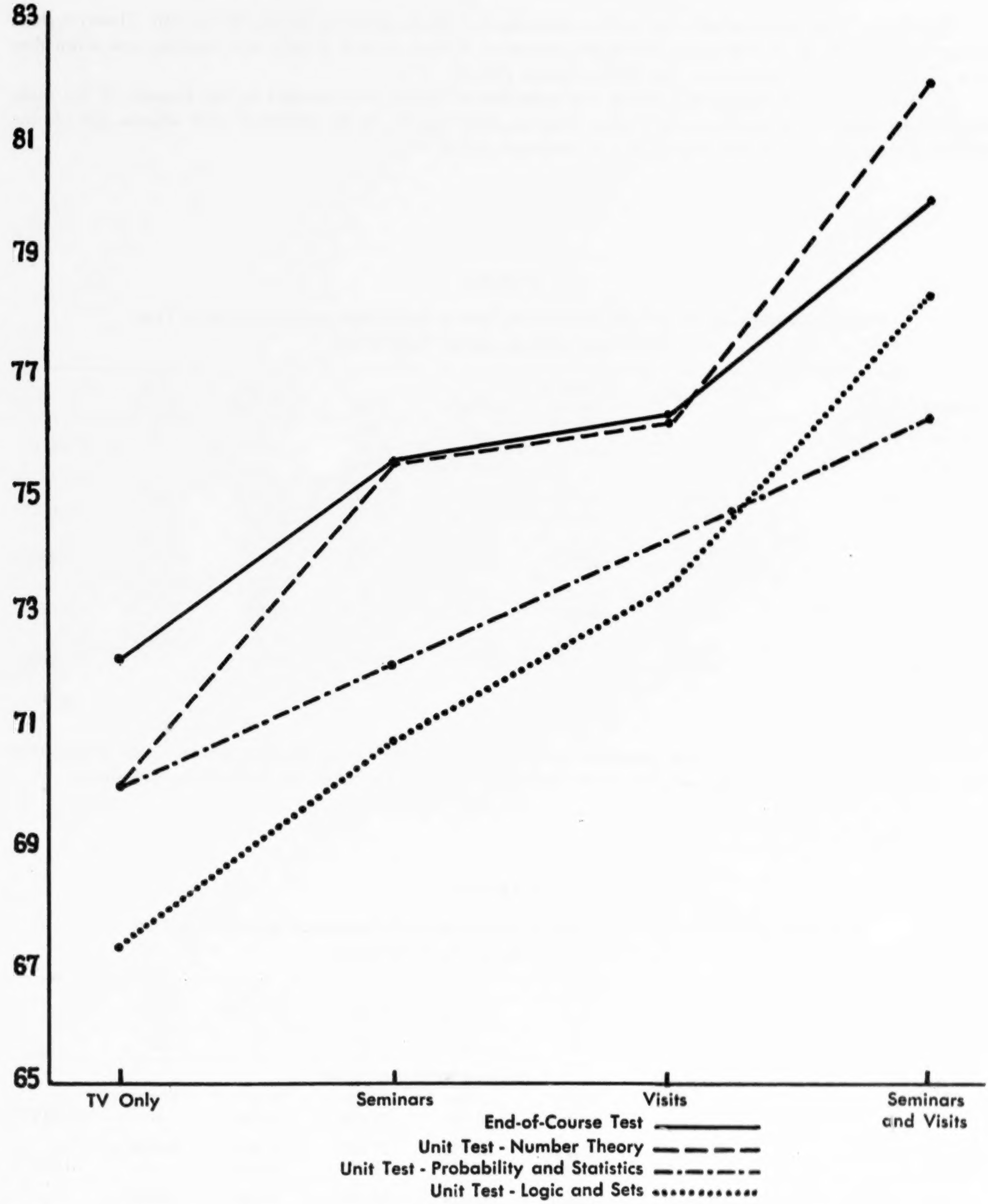

Figure 5: Adjusted Mean Scores of Concepts of Mathematics I Students in Staff-Constructed Achievement Tests by Treatment Groups.

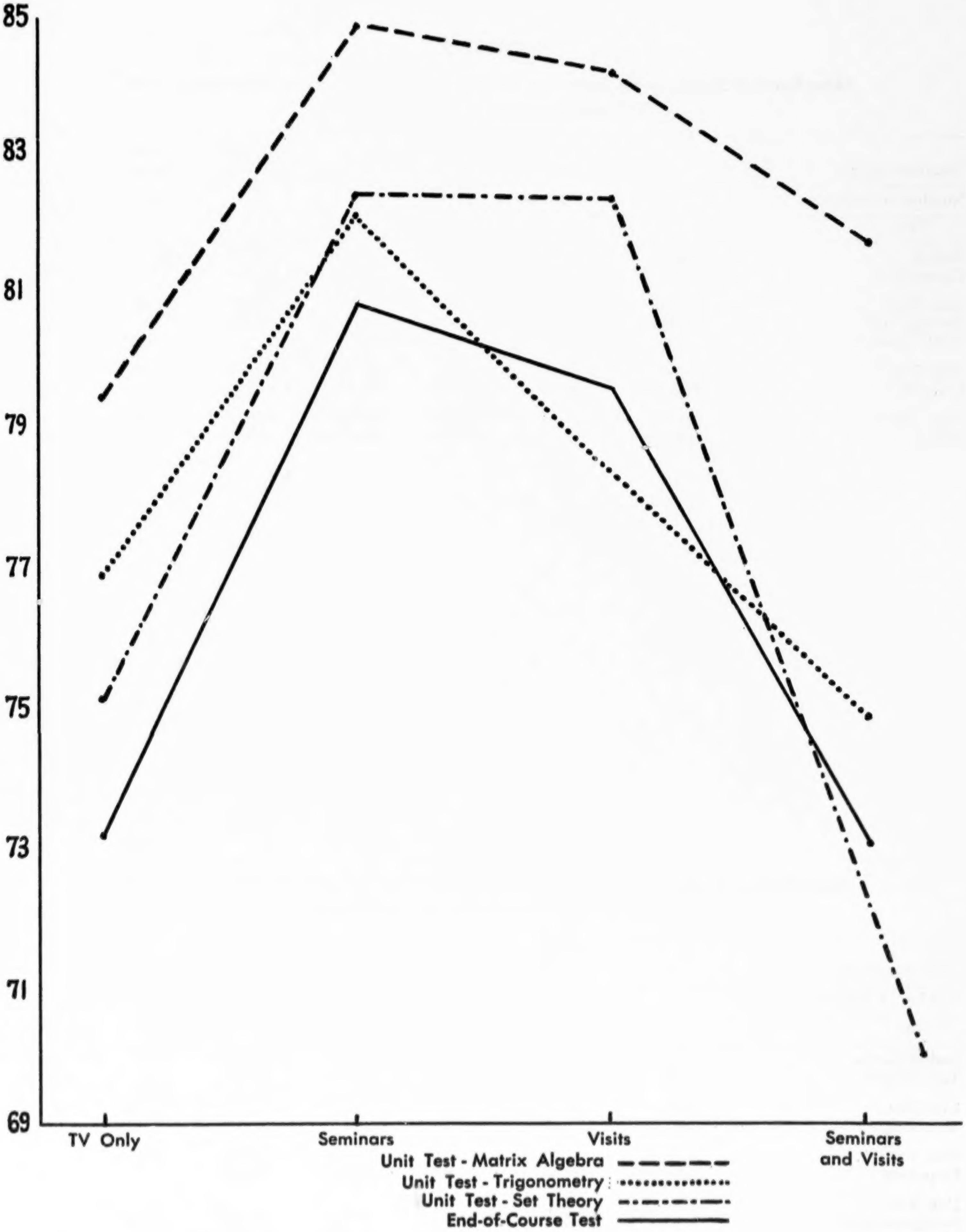

Figure 6: Adjusted Means Scores of Concepts of Mathematics II Students in Staff-Constructed Achievement Tests by Treatment Groups.

TABLE 7

Mean Scores of Science for the Space Age I Students in Staff-Constructed Achievement Tests by Treatment Group and for Total Group

Treatment Group		Television Only	Seminars	Visits	Seminars and Visits	Total Group	
Number of Students		56	28	77	26	187	F-ratio
Test		Mean Percentage Scores					
End-of-Course Test	Actual	35.875	29.143	30.266	31.019	30.385	
	Adjusted	31.482	29.615	30.654	31.491	–	2.107
Unit Test – Geology and Earth Science	Actual	31.034	32.214	30.546	33.269	31.28	
	Adjusted	31.297	32.366	30.669	33.421	–	.557
Unit Test – Chemistry	Actual	37.672	36.321	39.244	39.923	38.46	
	Adjusted	38.078	37.585	39.142	41.167	–	.964
Unit Test – Biology	Actual	22.517	22.964	22.546	23.692	22.74	
	Adjusted	22.678	23.044	22.648	23.772	–	.055

TABLE 8

Mean Scores of Science for the Space Age II Students in Staff-Constructed Achievement Tests by Treatment Group and for Total Group

Treatment Group		Television Only	Seminars	Visits	Seminars and Visits	Total Group	
Number of Students		11	15	35	14	75	F-ratio
Test		Mean Percentage Scores					
End-of-Course Test–Physics	Actual	32.45	34.065	33.614	36.536	34.08	
	Adjusted	32.239	33.697	34.221	36.166	–	.723
Unit Test – Astronomy	Actual	18.000	18.785	19.742	21.786	19.689	
	Adjusted	18.631	18.116	19.718	21.116	–	1.303
Unit Test – Propulsion	Actual	17.091	18.785	19.371	25.000	19.986	
	Adjusted	17.517	18.125	20.083	24.339	–	.923
Unit Test – Navigation and Electronics	Actual	21.90	26.000	27.829	30.286	27.067	
	Adjusted	22.114	25.714	28.019	29.999	–	2.53

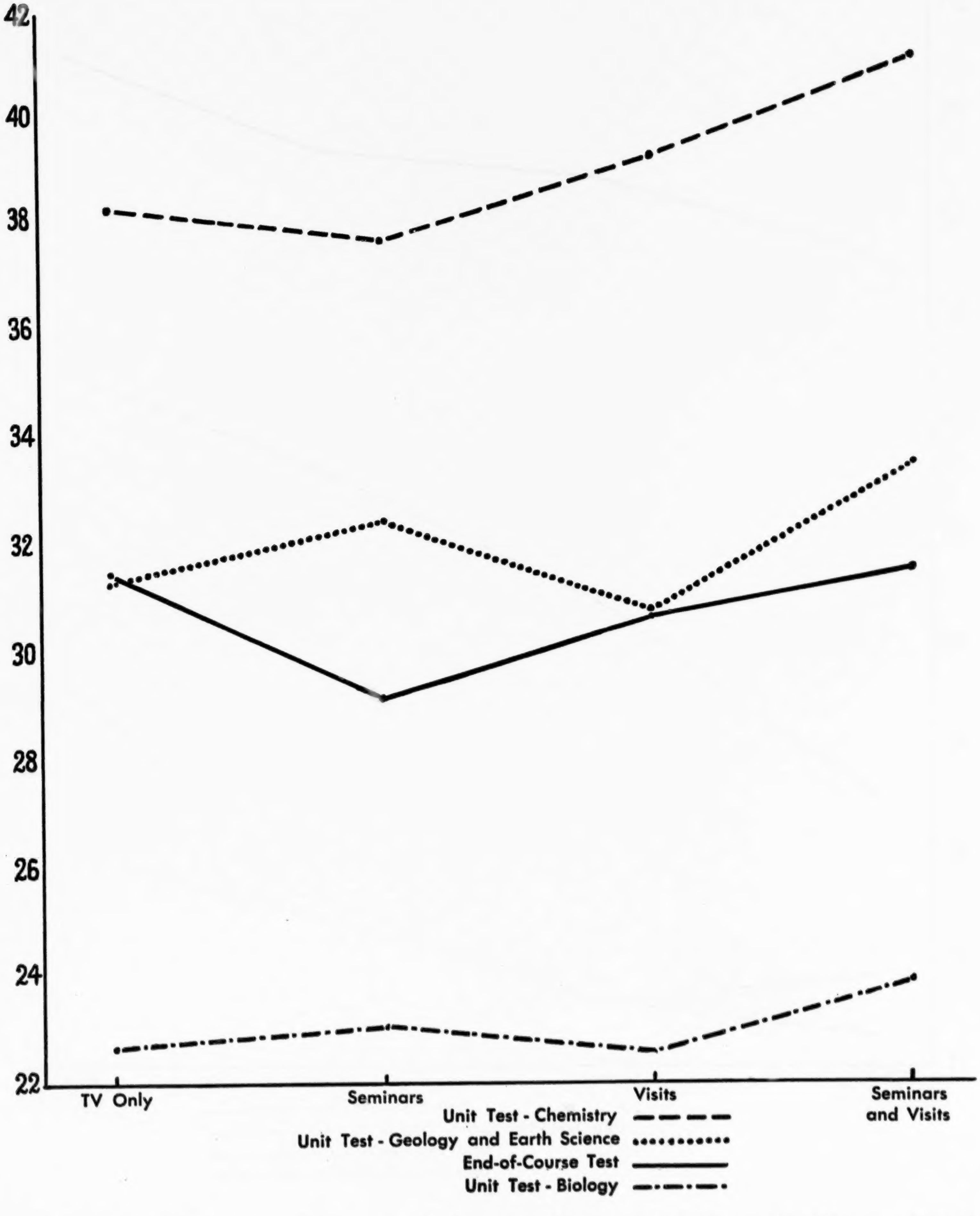

Figure 7: Adjusted Mean Scores of Science for the Space Age I Students in Staff-Constructed Achievement Tests by Treatment Groups.

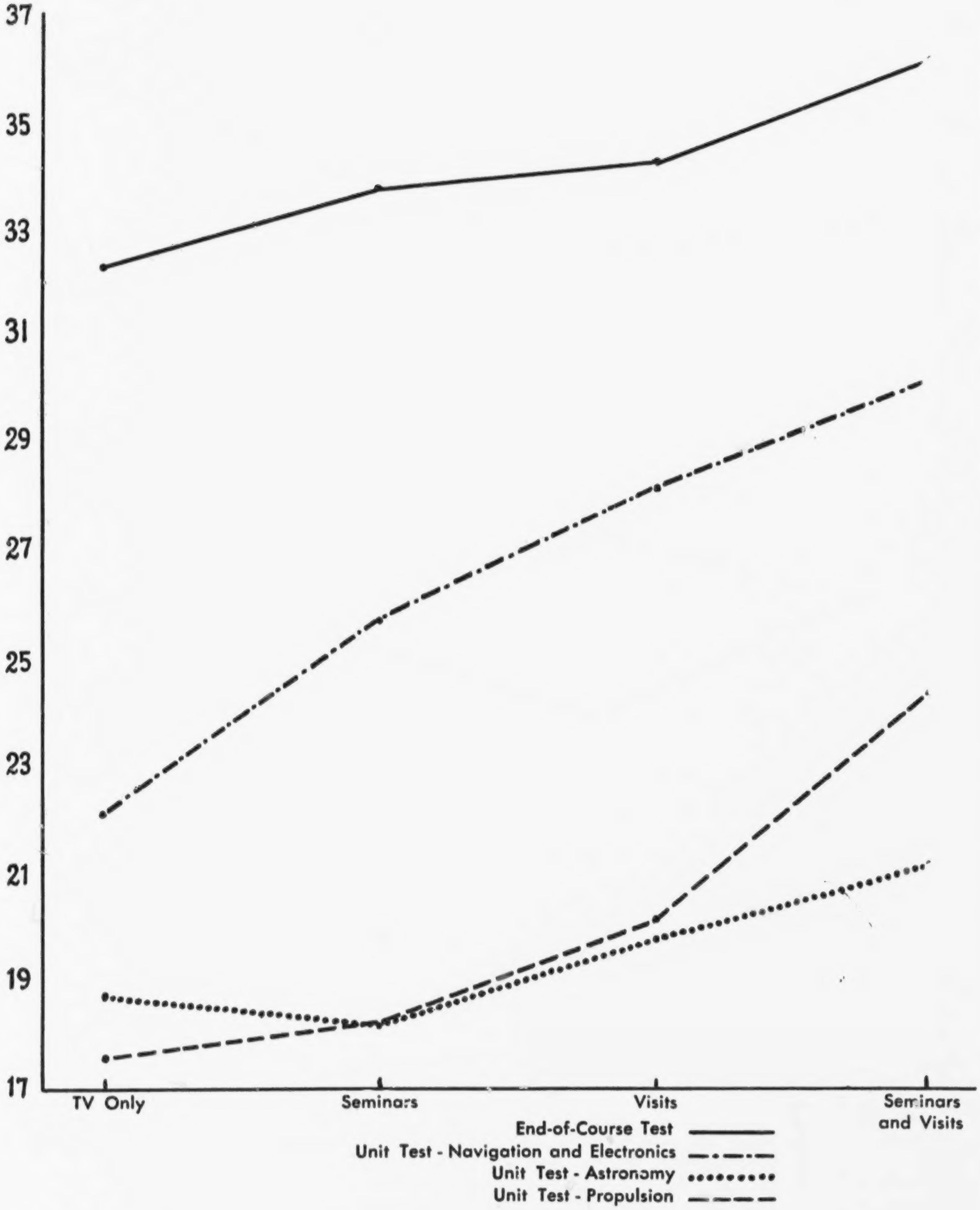

Figure 8: Adjusted Mean Scores of Science for the Space Age II Students in Staff-Constructed Achievement Tests by Treatment Groups.

TABLE 9

Gain in Related STEP in Mean Scores in Spring Administration of Tests over Fall Scores by Treatment Groups and for Entire Group

Course and Test	Treatment Group	Television Only	Seminars	Visits	Seminars and Visits	Total Group	F-ratio
Concepts of Mathematics I STEP Mathematics	Number of Pupils	107	62	11	37	217	
	Fall Mean Score	294.6422	298.2941	295.4507	293.3784	294.9530	
	Standard Deviation	11.2082	5.3442	11.1353	10.6399	10.8369	
	Gain in Spring Mean Score	3.2804	5.0909	3.9516	3.9189	3.6728	
	Adjusted Gain	3.0391	4.7191	3.9684	3.5471	3.6528	.080
Concepts of Mathematics II STEP Mathematics	Number of Pupils	68	81	38	15	202	
	Fall Mean Score	295.8143	298.5000	292.2696	290.6250	294.4225	
	Standard Deviation	10.2919	8.5494	10.9757	8.2906	10.4867	
	Gain in Spring Mean Score	5.1176	5.2368	4.0617	3.1333	4.5693	
	Adjusted Gain	5.9944	5.9580	3.1295	3.8545	5.2769	1.247
Science for the Space Age I STEP Science	Number of Pupils	57	28	83	26	194	
	Fall Mean Score	297.0357	291.4286	291.8052	300.5769	294.5347	
	Standard Deviation	12.1390	12.8325	13.5351	9.5803	12.4649	
	Gain in Spring Mean Score	9.0702	5.6785	8.8072	8.6538	8.4124	
	Adjusted Gain	8.5707	4.8201	8.5189	7.7953	6.8406	1.555
Science for the Space Age II STEP Science	Number of Pupils	10	12	29	11	62	
	Fall Mean Score	298.2727	300.2666	294.5714	303.0000	297.8266	
	Standard Deviation	12.5559	12.3097	14.8675	13.4642	14.1980	
	Gain in Spring Mean Score	1.0000	1.2500	5.4483	.9090	2.3065	
	Adjusted Gain	.6848	1.6794	3.8697	.4796	1.7297	1.052

Table 5 and Figure 5 show that the mean scores earned in 1959-1960 by the Concepts of Mathematics students increased consistently as the amount of assistance from project staff members increased. The pupils with no supplementary assistance earned the lowest mean scores; those with once-a-month seminars-only were next higher, those with bi-weekly visits were still higher, and the pupils who had both seminars and visits achieved the highest scores. The differences in mean scores among treatment groups were significant at the one per cent level for the end-of-course test and the unit test on logic and set theory. The differences for the two unit tests on number theory and probability and statistics were not significant.

Table 6 and Figure 6 show that in 1960-1961 in all tests the highest adjusted mean scores were earned by the group of students who had seminars only, and the second highest scores were obtained by a group which had more supplementary teaching, the visits-only group. In three tests the group with the most assistance — the students who had both seminars and visits — ranked lowest, and in one test had the second lowest mean score. These differences among groups were all significant at the one per cent level.

Table 7 and Figure 7 show that although in the first year of Science for the Space Age the adjusted mean scores generally increased numerically with the amount of supplementary service from project staff members, the differences were slight and were not significant.

Table 8 and Figure 8 indicate that in Science for the Space Age II the differences among the four treatment groups in mean adjusted scores on the four achievement tests were not statistically significant for unordered groups. Nevertheless, the consistency of the trend in the data was in agreement with the order of the treatment. This suggests that a more sensitive technique, taking into consideration the ordering of the groups, might have resulted in significance.

Table 9 and Figures 9 and 10 for gain scores show that in all instances the mean scores achieved in the spring administration of the tests were higher than the mean scores achieved the preceding fall. The greatest gain was in the STEP

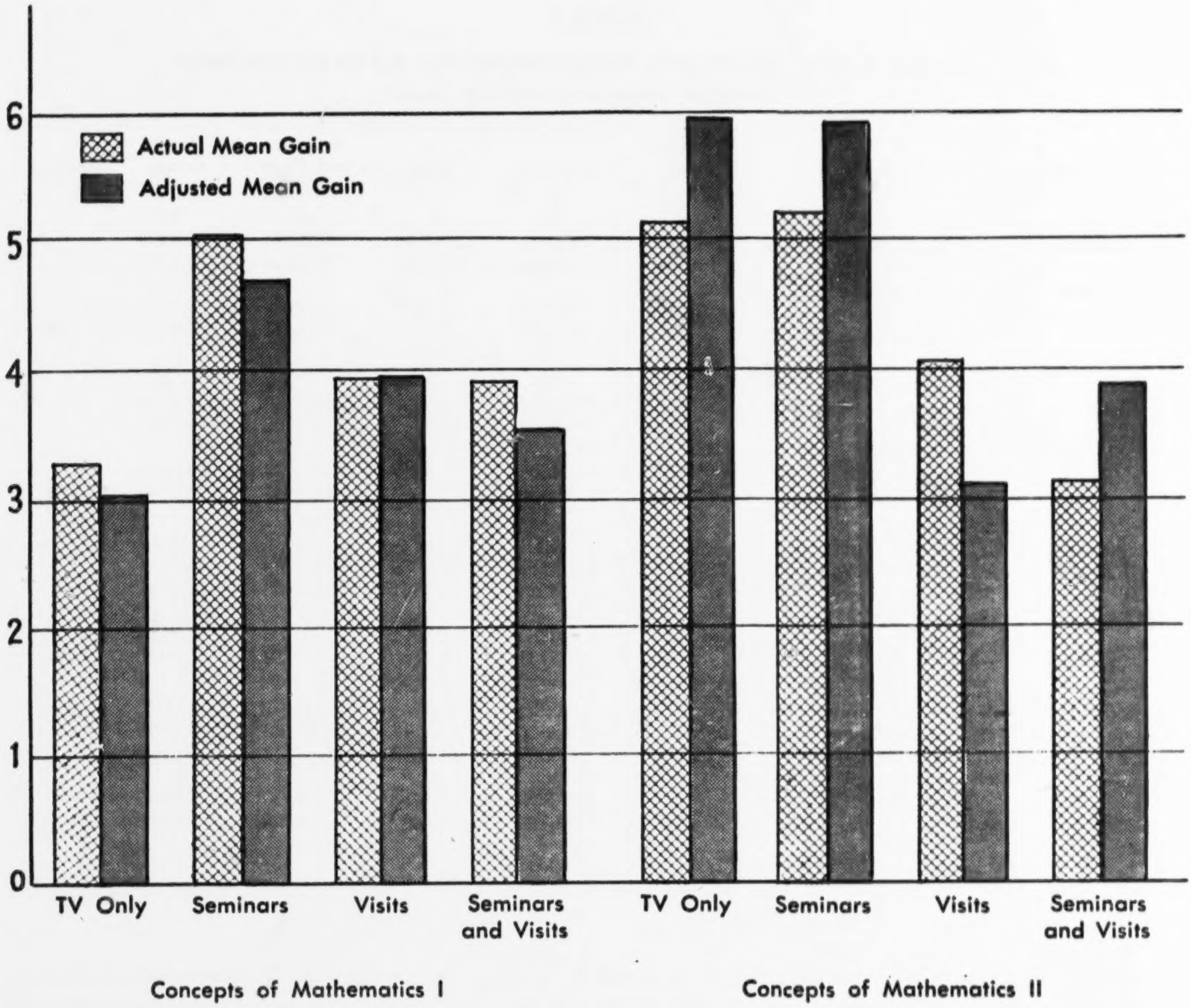

Figure 9: Mean Gains in STEP Mathematics Test Scores in Spring Administration as Compared to the Preceding Fall, by Treatment Groups.

Science for the Science for the Space Age I students. The second largest gain was shown by Concepts of Mathematics II, followed by Concepts of Mathematics I, and the least gain by Science for the Space Age II.

The variation in fall test scores was slight, and the scores themselves were relatively high. Since neither STEP covered much of the material presented in the televised courses, these tests measured only indirectly the effects of the course. The gain in score during the year was modest, and it is not possible to attribute this gain entirely to participation in the televised program.

There were no significant differences among treatment groups; consequently it seems proper to assume that the growth in proficiency as measured by these tests was not related to the amount of supplementary services provided. The TV-only group generally made about as much progress during the year as did any of the other treatment groups.

Study of these data led to the development of the following observations:

1. There was a trend during the first year toward higher scores on staff-constructed achievement tests in the mathematics courses when some supplementary teaching assistance was provided. This trend was not consistent the second year.

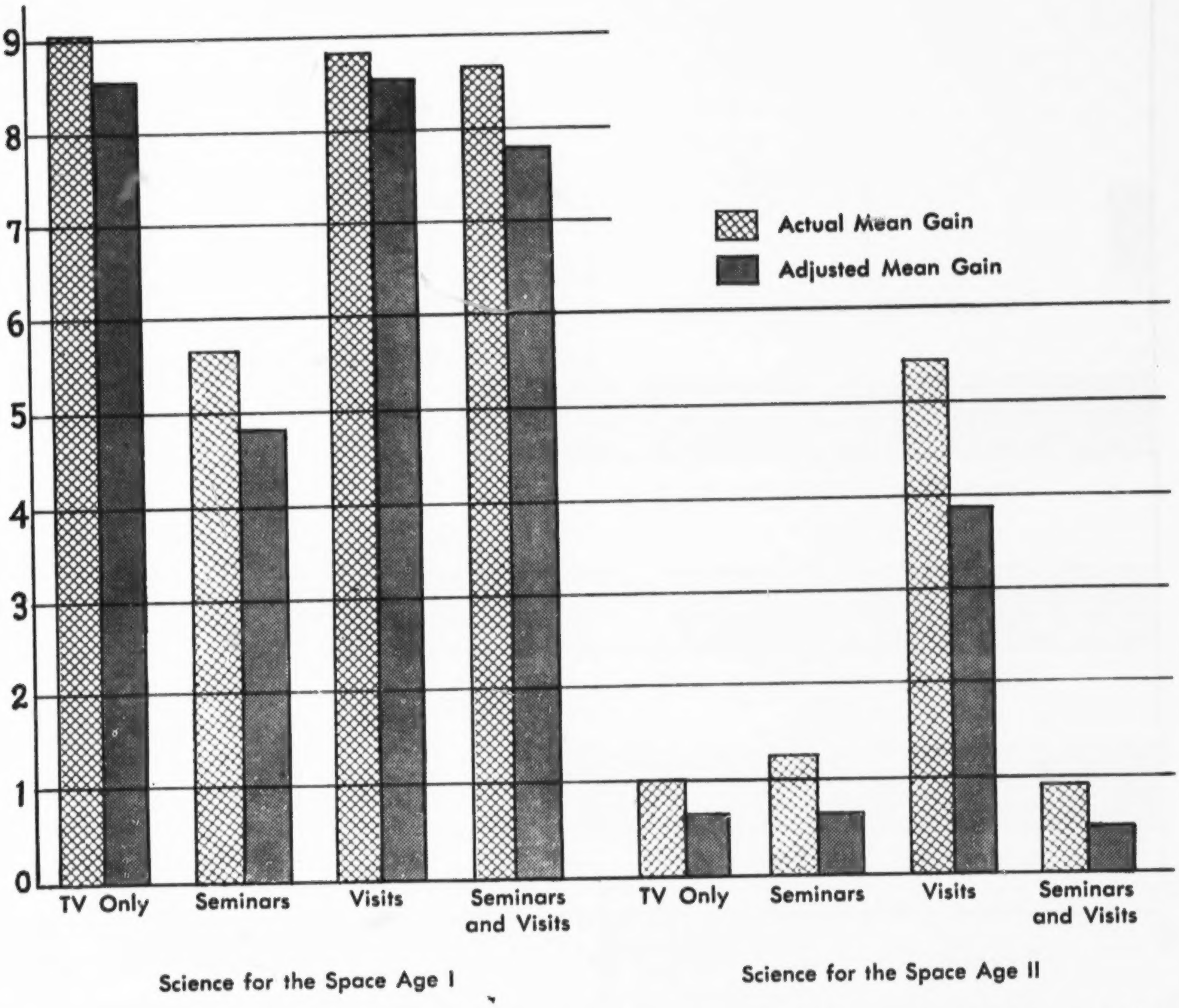

Figure 10: Mean Gains in STEP Science Test Scores in Spring Administration as Compared to the Preceding Fall, by Treatment Groups.

2. The TV-only students in the science courses did about as well in the achievement testing as did the other three groups.

3. The differential treatment of the subgroups did not produce significant results in the standardized testing. This is not surprising considering that the additional year of maturity, the overall effect of the televised courses, and the effect of the related courses which the pupils were taking concurrently produced such little gain on these measures.

It seems reasonable to conclude, consequently, that:

1. Capable students who enroll in a televised course such as the two in Concepts of Mathematics will learn somewhat more if they have some supplementary assistance from teachers who are competent in the subject matter presented. These pupils do not need a great deal of help; a little will suffice.

2. Capable students who take a televised course such as the two in Science for the Space Age can do as well without supplementary help from teachers trained in the subject matter presented as can pupils who have this additional aid.

3. This study suggests that pupil need for assistance supplementary to the televised instruction is dependent in part upon the nature of the subject matter of the course.

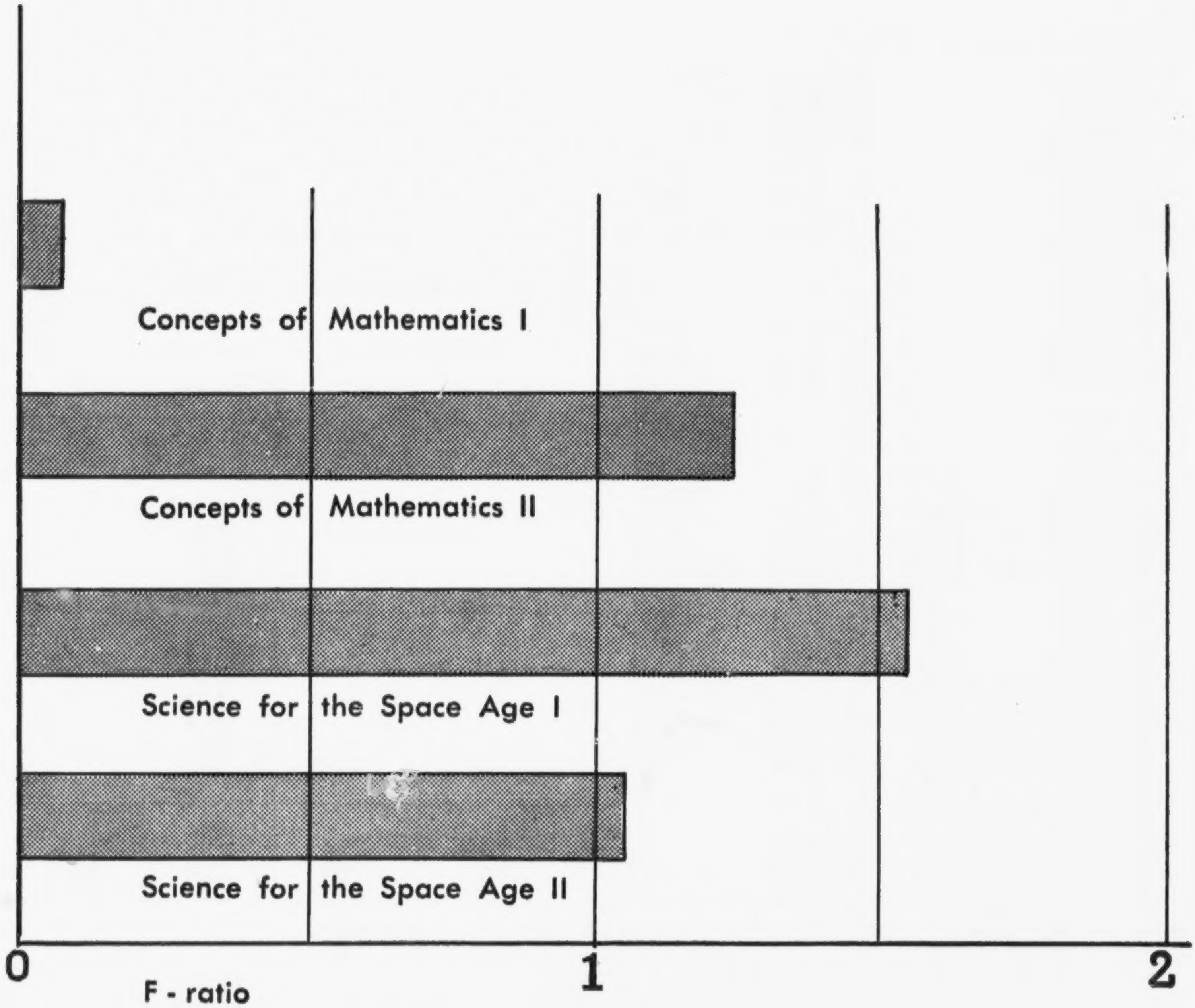

Figure 11: F-Ratios of Gain by Treatment Groups in Mean Scores on Related STEP Tests in Spring over Preceding Fall Scores.

THIRD HYPOTHESIS

Varying amounts and kinds of supervision by teachers competent in the subject presented will produce significant differences in the number and quality of additional projects undertaken by the pupils.

Participating students were encouraged by the project staff by several different means to undertake supplementary reading, independent study, and special projects. There was conscious, consistent effort to develop an attitude of inquisitiveness.

Among the steps taken by the television teachers and the assistant teachers were the following:

1. During the televised lessons the teachers periodically suggested ideas for further investigation by the students.
2. The students were invited frequently to write to the television teachers for assistance with their projects.
3. All assignment sheets listed recommended optional related readings.
4. In school visits and in seminars the assistant teachers frequently illustrated the possibilities of more intensive study of the topic presented on television. Research techniques were also discussed at these meetings.
5. Some "learning papers," each consisting of an explanation of a topic or of a process not presented on television and some suggested exercises, were prepared by staff members, mimeographed, and sent to each student.

6. Two sets of the 200-volume " Traveling High School Science Library " were loaned to the staff for the two years by the American Association for the Advancement of Science. Early in the first year, copies of the annotated index to this library were sent to each school, and through a covering letter, students were urged to borrow the books by mail for two-week periods. The television teachers frequently promoted use of this service and referred to individual volumes which provided valuable supplements to the mathematics and science courses.

   Requests for these books were so infrequent the first year that at any given time approximately 12 to 15 books were in circulation. In order to encourage greater use, 25-book, boxed sections of the Library were distributed to schools during the second year for two- and three-week periods.

In 1959-60, one " learning paper " on non-Euclidean geometry was mailed to all pupils enrolled in Concepts of Mathematics I. Three students from two secondary schools (both with seminars and visits) submitted written reports indicating completion of the suggested work.

In 1960-61, two " learning papers " were prepared and distributed, one on algebraic functions and the other on transformations in a plane. Two boys (one in a school with seminars only, the other visits only) reported completion of the first paper; none reported completion of the second.

A grade 11 girl (no seminar or visits) in Concepts of Mathematics I submitted a research paper entitled "Even Magic Squares." A grade 12 girl (seminars only) in the same course used ideas obtained from the course to prepare material for a mathematics contest in her school in which she won first prize. A senior class boy (no seminars or visits) in Concepts of Mathematics II submitted a research paper on prime numbers.

A grade 11 girl (visits only) in Science for the Space I experimented with mice. One series of tests was concerned with the teratogenic effects of hypervitaminosis A over prolonged periods of time and in succeeding generations in determining hereditary mutations. The mice were exhibited on the program and the student explained her experiment.

In Science for the Space Age II, an eleventh grade boy (visits only) constructed a rocket frame and requested information concerning rocket fuels.

During both years a group of students in one participating school (seminars and visits) built and launched successfully several rockets under the supervision of the school's physics teacher. During the second year a six-foot two-stage rocket was successfully launched electronically. The second stage was activated by a mercury switch.

Extensive use was made during the second year by the students in both televised courses of the boxes of Traveling High School Science Library books. Visiting teachers found that the students generally were unwilling to relinquish a 25-book set unless it was replaced by another.

In school visits and seminars, students asked assistant teachers to lend them copies of their own college-level texts for supplementary reading. Approximately forty per cent of the students with whom the assistant teachers worked made this request at some time each year.

There may have been more projects or independent study, but the staff could report only on the work they knew about.

After reviewing these data, the project staff formed the following conclusions:

1. There are insufficient data to test satisfactorily the hypothesis.
2. The data are insufficient to indicate that the programs stimulated additional projects or independent study, but this insufficiency indicates that there was less work of this type than had been expected.
3. Both groups of teachers were successful in motivating a high proportion of the pupils to undertake additional reading when supplementary reading materials were made easily accessible.
4. The students said that their regular curricular load was too heavy to permit them to undertake additional projects.

FOURTH HYPOTHESIS

A competent television teacher can stimulate able pupils to the extent that significant changes may be observed in their learning attitudes, educational plans, and vocational aspirations.

To test this hypothesis, four instruments were used — " Sizing Up Your School Subjects," a project-developed " Student Attitude Questionnaire," a staff-built " Biographical Aspirations Inventory," and " Facts About Science."

SUYSS Test Results

Sizing Up Your School Subjects (SUYSS) was administered in the spring of each year. Each of the ten questions in the test sought to compare the attitude of the students toward the televised courses in comparison with their regular school subjects.

TABLE 10

Means and Critical Ratios of Student Ratings of the Televised Courses in Comparison with Their Other Mathematics and Science Courses in the SUYSS Test, 1959-1960

Question Number		Concepts of Mathematics I vs. English and Regular Mathematics Courses				Concepts of Mathematics I vs. English and Regular Science Courses				Science for the Space Age I vs. English and Regular Science Courses				Science for the Space Age I vs. English and Regular Mathematics Courses			
		TV Only	Seminars	Visits	Seminars and Visits	TV Only	Seminars	Visits	Seminars and Visits	TV Only	Seminars	Visits	Seminars and Visits	TV Only	Seminars	Visits	Seminars and Visits
1	Mean	.523	1.000	.836	1.000	.653	1.000	.980	.957	.843	1.100	.875	.681	.772	.833	.918	.483
	C. R.	—	1.492	2.149*	1.320	—	.835	3.056*	1.434	—	.967	.050	(-) .913	—	.299	.974	(-)1.670
2	Mean	.375	.286	.260	.412	.176	.500	.229	.375	.368	.200	.178	.040	.228	.294	.443	.208
	C. R.	—	(-).438	(-)1.008	.193	—	1.082	.519	2.238*	—	(-)1.111	(-) .217	(-)3.088*	—	.472	1.824	(-) .151
3	Mean	.190	.000	.200	.133	.230	.250	.292	.136	.132	.100	.185	.083	.147	.000	.123	.291
	C. R.	—	(-)3.220*	.105	(-) .543	—	.078	.558	(-) .758	—	(-) .267	.060	(-) .523	—	(-)1.988*	(-) .239	1.075
4	Mean	.531	.429	.360	.867	.554	.750	.341	.943	.421	.777	.426	.240	1.172	.760	.474	.291
	C. R.	—	(-) .324	(-)1.238	1.295	—	.742	(-)1.638	3.076*	—	1.040	.003	(-)1.295	—	(-)1.813	(-)5.160*	(-)6.000*
5	Mean	.328	.714	.764	.647	.617	1.000	.913	.880	.395	.800	.527	.520	.428	.648	.627	.542
	C. R.	—	1.955	3.574*	1.444	—	2.900*	2.086*	.970	—	1.778	.988	1.494	—	1.090	1.411	.658
6	Mean	1.556	2.000	1.327	1.293	1.475	1.750	1.250	1.168	1.538	1.600	1.232	1.400	1.200	1.530	1.150	1.324
	C. R.	—	5.550*	(-)1.802	(-)1.632	—	1.425	(-)1.541	(-)1.826	—	.317	(-)2.128*	(-) .780	—	1.674	(-) .321	.902
7	Mean	.375	.857	.624	.529	.668	1.500	.896	.708	.342	.800	.585	.560	.428	.235	.533	.417
	C. R.	—	1.773	1.907	.906	—	5.240*	1.634	.204	—	1.484	1.797	1.252	—	(-)1.083	.719	(-) .066
8	Mean	.328	.286	.333	.824	.333	.000	.429	.833	.595	.182	.604	.400	.568	.059	.607	.417
	C. R.	—	(-) .210	.044	2.582*	—	(-)4.500*	1.279	2.488*	—	(-)2.501*	.006	(-)1.091	—	(-)2.462*	.231	(-) .763
9	Mean	1.606	1.857	1.355	1.233	1.528	1.500	1.255	1.303	1.512	1.600	1.245	1.440	1.242	1.472	1.187	1.457
	C. R.	—	1.530	(-)1.874	(-)1.734	—	(-) .097	(-)1.993*	(-)1.266	—	.458	(-)2.020*	(-) .464	—	1.085	(-) .344	1.119
10	Mean	.656	.286	.796	1.000	.695	.500	.878	1.040	.694	.700	.679	.560	.744	.765	.700	.625
	C. R.	—	(-)1.229	.921	1.495	—	(-)1.211	1.227	1.855	—	.025	(-) .101	(-) .765	—	.088	(-) .273	(-) .662
Modal Number of Responses		64	7	50	17	74	4	48	24	38	10	56	25	35	17	60	24

* Significant at 5 per cent level.
** Significant at 1 per cent level.

TABLE 11

Means and Critical Ratios of Student Ratings of the Televised Courses in Comparison with Their Other Mathematics and Science Courses in the SUYSS Test, 1960-1961

		Concepts of Mathematics II vs. English and Regular Mathematics Courses				Concepts of Mathematics II vs. English and Regular Science Courses				Science for the Space Age II vs. English and Regular Science Courses				Science for the Space Age II vs. English and Regular Mathematics Courses			
Question Number		TV Only	Seminars	Visits	Seminars and Visits	TV Only	Seminars	Visits	Seminars and Visits	TV Only	Seminars	Visits	Seminars and Visits	TV Only	Seminars	Visits	Seminars and Visits
1	Mean	.877	1.050	.652	1.000	.949	.927	.884	.667	.625	.799	1.050	.497	.600	1.333	.963	.416
	C. R.	—	1.073	(-)1.594	.334	—	(-) .125	(-) .412	(-)1.250	—	.693	1.795	(-) .709	—	2.560*	1.729	(-) .866
2	Mean	.440	.300	.197	.572	.308	.222	.449	.417	.250	.862	.400	.314	.000	.444	.346	.167
	C. R.	—	(-)1.015	(-)2.314*	.637	—	(-) .785	1.343	.456	—	1.086	.757	.712	—	2.520*	3.642*	1.475
3	Mean	.268	.300	.182	.143	.359	.148	.290	.083	.000	.624	.150	.832	.100	.111	.231	.333
	C. R.	—	.166	(-) .753	(-) .749	—	(-)1.335	(-) .499	(-)1.902	—	1.722	1.875	1.509	—	.744	.813	.951
4	Mean	.575	.368	.349	.429	.448	.308	.353	.833	.143	.924	.500	.416	.444	.555	.538	.167
	C. R.	—	(-)1.090	(-)1.794	(-) .689	—	(-) .922	(-) .805	1.355	—	1.941	1.858	.385	—	.325	.414	(-)1.784
5	Mean	.683	.130	.757	.858	1.025	1.260	1.015	.500	.750	.645	.900	.416	.600	.555	.847	.333
	C. R.	—	(-)3.167*	.649	.691	—	1.237	(-) .069	(-)2.808*	—	(-) .792	.571	(-) .097	—	(-) .125	1.015	(-)1.045
6	Mean	1.474	1.263	1.616	1.143	1.205	1.345	1.328	1.420	1.000	.640	1.210	.497	1.300	1.000	1.280	1.667
	C. R.	—	(-)1.425	1.203	(-)1.000	—	.795	.848	.844	—	(-) .307	.790	(-)1.713	—	(-) .968	(-) .068	1.235
7	Mean	.854	1.110	.724	1.000	.975	.963	.898	1.000	.375	.745	.950	.817	.400	.607	.847	.500
	C. R.	—	1.282	(-) .940	.400	—	(-) .671	(-) .506	.083	—	1.013	2.237*	.857	—	.746	1.753	1.132
8	Mean	.800	.650	.538	.429	.948	.815	.638	.250	.572	.759	1.050	.866	.555	.667	.847	.546
	C. R.	—	(-) .628	(-)1.626	(-)1.275	—	(-) .606	(-)2.039*	(-)3.835*	—	.029	1.355	.163	—	.298	.979	(-) .026
9	Mean	1.025	1.350	1.495	.667	1.025	1.332	1.148	.910	1.250	.799	1.100	.471	1.500	1.222	1.120	1.728
	C. R.	—	2.019*	3.507*	(-)1.014	—	1.805	.809	(-) .412	—	(-) .241	(-) .498	(-)1.390	—	(-) .779	(-)1.386	.862
10	Mean	.464	.850	.652	.848	.667	.705	.794	.750	.750	.850	.750	.685	.600	.667	.847	.333
	C. R.	—	2.231*	1.542	1.874	—	.200	.835	.336	—	.233	.000	(-) .879	—	.234	1.093	(-)1.231
Modal Number of Responses		41	20	65	7	39	27	68	12	8	12	20	9	10	9	26	12

* Significant at 5 per cent level.
** Significant at 1 per cent level.

Tabulations were made of the relative position of the televised courses on a five-point scale in comparison with English and regular mathematics courses and with English and a conventional science course. If the televised course was rated above both English and science or mathematics, this response was recorded as a "2"; if it was rated between English and the conventional science or mathematics, it was rated "1"; if it was below both, it was rated as "0." The means of these ratings and the critical ratios of the mean ratings by the other three experimental groups compared with the means of the TV only group are listed in Tables 10 and 11.

Question 1. " How do you like the subjects you are now studying?"
Hypothesis: The more face-to-face help the student received the better he would like the subject.

Table 10 indicates that in 1959-1960 the students who had visits only liked Concepts of Mathematics I better than the pupils who had TV only. Table 11 shows that in 1960-1961 the pupils who had seminars only liked Science for the Space Age II better than the pupils in the TV-only group. Thus, in three of 24 comparisons, the pupils with some supplementary assistance indicated that they liked the televised courses better than did the pupils with no personal contacts with the assistant teachers. In all other cases the differences in mean ratings were not statistically significant.

These data seem to indicate that there is little correlation between student liking for televised courses such as these and the amount of face-to-face assistance given by project teachers.

Question 2. " How much time do you actually spend on the subjects you are now studying — both at school and at home?"
Hypothesis: The students would spend less time on the televised courses than on their regular subjects.

Tables 10 and 11 show that in both years both televised courses ranked low in comparison with the students' regular subjects in the amount of time devoted to study.

During the first year there was no statistical difference among the treatment groups in the amount of studying reported in the televised courses in comparison with the amount of studying in their regular courses except for two cases. The Concepts of Mathematics students who had both seminars and visits reported relatively more study in this area than the TV-only group in comparison with English and regular mathematics courses. The Science for the Space Age students who had both seminars and visits reported relatively less study of the televised course in comparison with English and regular science courses.

During the second year the Concepts of Mathematics pupils who had visits only said that they studied this course proportionately less than did the TV-only group in comparison with English and mathematics. Both the visits-only and the seminars-only groups reported more study of Science for the Space Age II in comparison with English and conventional mathematics than did the TV-only group. In all other cases there were no statistically significant differences among the treatment groups in the second year.

It would appear that generally the students spent less time in completing assignments or in other related study in the televised courses than they did in their regular courses in English, mathematics, and science. One also may conclude from these data that the lack of face-to-face contact between project teachers and students generally did not affect significantly the amount of study-time in the televised courses.

Question 3. " How often do you have a chance to ask the teacher questions in your different subjects?"
Hypotheses: The televised courses are the ones in which the pupils would have the fewest opportunities to ask questions. The students in the TV-only group would have the least opportunity to ask questions.

Tables 10 and 11 both indicate that as a whole the students believed they had less opportunity to ask questions in the televised courses than in their regular courses in English, mathematics, and science. The means are low. One possible explanation for the fact that they are as high as they are in the groups which received service from project staff members may be that the students in some schools felt that the visits provided more opportunity to ask questions than their regular teachers permitted in conventional teaching. The existence of mean scores above zero in seven of the eight TV-only groups may indicate that the teachers in some schools attempted to supplement the televised course with some personal assistance, that they may have felt free to write to the television teacher, or that a " halo " effect was operating.

In Table 10 there were only two instances of significant differences among groups in their estimate of the relative ability to ask the teacher questions. The Concepts of Mathematics I pupils in the seminars-only group reported less opportunity to ask the teacher questions in comparison with English and mathematics than the TV-only group. The Science for the Space Age I pupils in the visits-only group reported the same tendency. In Table 11 there were no significant differences among the treatment groups.

Although the students' answers generally suggest that the pupils felt that there was less opportunity for them to ask questions in the televised courses than in their regular subjects, there is little indication that the absence or existence in varying amounts of assistance by project staff members affected significantly these responses.

Question 4. "How often do your subjects (classwork and homework) keep you from taking part in outside activities you would rather do?"

Hypotheses: Because of less immediate supervision, the televised courses would to a lesser extent than their regular subjects tend to keep pupils from taking part in outside activities they would prefer to do. On the other hand, the visits and especially the seminars would conflict with outside activities for the groups with these services.

Tables 10 and 11 show that generally the pupils reported that the televised courses interfered with preferred outside activities somewhat less than did English and other mathematics and science courses. The mean ratings of the extent to which Concept of Mathematics in comparison with their other courses prevented the pupils from taking part in outside activities were somewhat higher for the first year than the second year.

During the first year three of the twelve comparisons among treatment groups show significantly different results, and these are in opposite directions. In comparing Concepts of Mathematics with their regular English and science courses, the pupils in the seminars and visits group reported that the televised course interfered with their outside activities more than did the TV-only group. The visits-only and the seminars and visits groups indicated that they believed Science for the Space Age interfered with their outside activities less than did the TV-only group.

During the second year there were no significant differences among groups.

These data seem to indicate that the televised courses did to a somewhat lesser extent than conventional courses prevent pupils from participating in activities which they would have preferred. Also, the amount of supplementary service through visits and seminars, even though the seminars were always conducted outside of regular school hours, did not affect the degree to which pupils reported interference with their outside activities.

Question 5. "How easy to learn are the subjects you are now studying?"

Hypotheses: The televised courses were more difficult to learn than conventional courses. Pupils with more face-to-face assistance from staff members would find the course easier than those with less service.

Fifteen of the sixteen mean scores in Table 10 and thirteen of the mean scores in Table 11 indicate that the pupils on a whole found the televised courses more difficult to learn than their regular subjects. In 1960-1961, the TV-only, seminars-only, and visits-only groups had mean scores above 1.000 in comparing the difficulty of learning Concepts of Mathematics with English and regular science courses, thus indicating little difference.

During the first year the mean ratings of the TV-only groups were lower than those by all other treatment groups in all instances, thus indicating a greater degree of comparative difficulty. In the four comparisons during the second year there were seven instances where the means of the treatment groups with seminars and/or visits were lower than that of the TV-only group.

During 1959-1960, the visits-only group reported that Concepts of Mathematics was easier in comparison with English and other mathematics courses and with English and other science courses than did the TV-only group.

In 1960-1961, the Concepts of Mathematics seminars-only pupils reported a greater degree of difficulty than the TV-only group in comparison with English and other mathematics courses. The seminars and visits group indicated more difficulty than did the TV-only group in comparing Concepts of Mathematics with English and conventional science courses.

These data seem to indicate that the pupils as a whole believed the televised courses to be more difficult than their regular school subjects. Also, the provision of supplementary services by assistant teachers did not affect significantly the pupils' estimate of the difficulty of the experimental courses.

Question 6. "To what extent do you consider your different subjects useless to you?"

Hypothesis: The students would appreciate the value to them of carefully designed, well taught courses in mathematics and science.

In all instances except two, both occurring in the second year in a comparison of Science for the Space Age with English and other science courses, the mean scores of all groups were higher than 1. This indicates that generally, the pupils ranked the televised courses as being relatively less useful than English or their regular science and mathematics courses.

In 1959-1960, the seminars-only group ranked Concepts of Mathematics as being relatively more useful than English or other mathematics courses than did the TV-only pupils. The visits-only students reported that they believed Science for the Space Age relatively less useful in comparison with English and conventional science courses than did the TV-only group.

In 1960-1961, there were no significant differences among treatment groups.

Apparently, the students did not believe the televised courses were as valuable as their regular school subjects, and this opinion was not related to the amount of supplementary service provided through seminars and visits.

Question 7. "To what extent is the teaching in your different subjects clear and understandable?"
Hypotheses: The televised courses were less clear and understandable than conventionally taught courses. Pupils with more direct assistance from staff members would consider the courses clearer and more understandable than those with less service.

In fifteen of the sixteen cases in 1959-1960 the mean scores indicated that the students found the televised courses less clear and understandable than their regular subjects. The mean ratings in 1960-1961 generally were more favorable to the televised courses, but in only three instances were the means as high as 1.000, a rating which indicates equality with the other school subjects.

In comparing Concepts of Mathematics I with English and a regular science course, the seminar group rated the televised course higher than did the TV-only group. The visits-only group rated Science for the Space Age II significantly clearer and more understandable in comparison with English and a regular science course than did the TV-only group. All of the other comparisons among groups showed no significant differences.

These data indicate that the first hypothesis was valid — the students generally found the televised courses less clear and less understandable than their regular subjects. The second hypothesis seems to be invalid, because while the mean ratings by the TV-only groups are generally lower than those by the groups with varying services, most of the differences are not significant and there are no consistent trends.

Question 8. "How much serious discussion among students goes on in class in your different subjects?"
Hypothesis: The amount of serious discussion would vary directly with the amount of face-to-face assistance provided in the subject.

In 1959-1960, the group with both seminars and visits reported more serious discussion than did the TV-only group in comparing Concepts of Mathematics with English and a regular mathematics course. The seminars and visits group indicated more serious discussion than did the TV-only group in comparing Concepts of Mathematics with English and a science course, but in the same comparison, the seminars only students reported significantly less discussion than the TV-only group.

In Science for the Space Age I, both seminars-only groups reported less serious discussion than in the TV-only groups in comparison with English and a regular science course and with English and a regular mathematics course.

In 1960-1961, both the visits-only and the visits-and-seminars groups indicated less serious discussion than did the TV-only group in comparing Concepts of Mathematics with English and a conventional science course. All other differences among groups were not statistically significant.

The low mean ratings indicate that there was less class discussion in the TV course than in regular school subjects. It would appear that there was a slight trend toward more serious discussion in the televised classes where there was no assistance provided by project staff members, but the trend is not consistent.

Question 9. "How much does your mind wander in your different subjects?"
Hypothesis: The students' minds would wander least during the televised lessons.

The visits-only group reported less mind-wandering than did the TV-only pupils in comparing Concepts of Mathematics I with English and a regular science course. The visits-only students indicated less mind-wandering than the TV-only group in comparing Science for the Space Age I with English and a regular science course.

In 1960-1961, the seminars-only and the visits-only groups reported that their minds wandered more in the Concepts of Mathematics course than did the TV-only group in comparing this televised course with English and a conventional mathematics course.

Generally, the mean ratings were high, this indicating more mind-wandering in the televised courses than in regular subjects. This may in part be due to the lack of teacher supervision of some television classrooms. There was no trend among the groups.

Question 10. "How much do you learn from your different subjects?"
Hypothesis: The students would learn more in the carefully planned televised courses than in their regular subjects.

In 1959-1960, there were no significant differences among groups. In 1960-1961, there was only one instance of a significant difference between the TV-only group and the other three treatments. The seminars-only students rated Concepts of Mathematics higher than did the TV-only group in comparison with English and a regular mathematics group.

Most of the mean ratings were low, which indicates that as a group the students indicated that they learned less in the televised courses than in their regular subjects. The amount and kind of supplementary assistance from project staff members did not materially affect this rating.

TABLE 12

Mean SUYSS Ratings by Course and Treatment Group

Course	Treatment Group	TV-Only	Seminars	Visits	Seminars and Visits	Total Group	F-ratio
Concepts of Mathematics I	Number of Pupils	93	5	58	29	185	
	Actual Means	22.903	20.400	20.896	19.827	21.724	
	S. D.	5.745	5.161	6.031	4.885	5.829	
	Adjusted Means	22.879	26.409	20.930	25.340	–	2.890*
Concepts of Mathematics II	Number of Pupils	60	33	86	15	194	
	Actual Means	20.683	22.030	21.535	21.333	21.340	
	S. D.	5.091	4.475	5.101	7.162	5.211	
	Adjusted Means	20.672	24.446	21.356	24.244	–	1.040
Science for the Space Age I	Number of Pupils	50	20	72	26	168	
	Actual Means	22.340	24.150	21.555	22.846	22.297	
	S. D.	5.175	5.112	5.230	4.092	5.107	
	Adjusted Means	22.296	21.370	21.616	22.662	–	1.420
Science for the Space Age II	Number of Pupils	11	14	29	12	66	
	Actual Means	22.818	20.857	20.931	25.166	22.000	
	S. D.	4.509	6.334	6.464	4.160	6.010	
	Adjusted Means	22.845	27.068	20.751	31.304	–	1.754

Table 12 and Figure 12 show that for the questionnaire as a whole, only in Concepts of Mathematics I were there significant differences among the treatment groups in pupil attitude toward the televised course in comparison with regular subjects. Even here the trend was not consistent with increased face-to-face help to students by project staff members.

Course Attitude Questionnaire

This instrument was prepared in an effort to obtain data concerning the attitudes of the students toward the televised courses. There were 36 questions, divided among six categories: general evaluations (8), difficulty of course (7), attention (3), application (3), independent additional work (11), and mechanical problems (4). In each question students were asked to rate the televised course in comparison with their regular school subjects on a five-point scale.

Two copies of the questionnaire were completed by the students in April 1961. On one copy they were asked to respond according to their present attitudes; on the other, according to their recollections of their attitudes early the preceding fall.

Completed questionnaires were received in the spring of 1961 for 213 students. Of this number, 157 were enrolled in Concepts of Mathematics II, 44 in Science for the Space Age II, and 12 in both courses. Seven students who were taking both courses differentiated between them in their responses; five did not. In the tabulations these 12 were added to both the mathematics and the science tallies, providing a total of 225 responses, 169 of a possible 213 in mathematics and 56 of a possible 75 in science. The questionnaire and the frequency distribution of responses are contained in Appendix B.

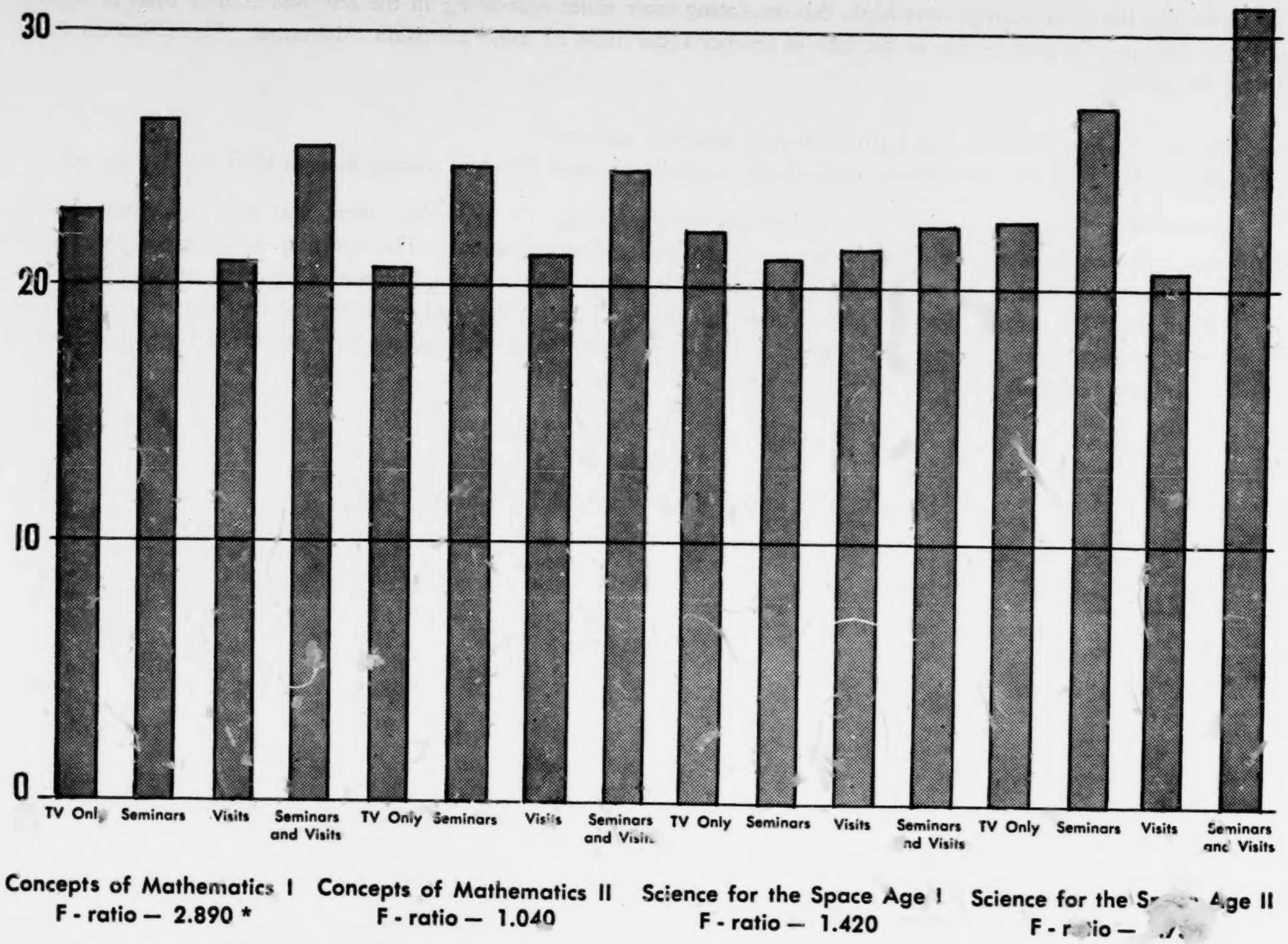

Figure 12: Adjusted Mean SUYSS Ratings by Course and Treatment Group.

The number and the percentage of students in each course who gave each of the five possible ratings to each of the 36 questions and the total number and percentage of students in both courses are tabulated for both the fall and the spring questionnaires in Appendix C.

Chi-Square tests of the significance of the differences of the fall and spring responses to each question were made separately for the mathematics and science students. These data are contained in Appendix C.

The change in attitude was significant at the five per cent level or higher in 19 of the 36 questions for the 169 mathematics students and in 8 questions for the 56 science students.

Table 13 shows that in 27 of the 36 questionnaire items the level of significance of the reported change in attitude toward the televised mathematics course was higher than that of the science course; in 5 cases the significance level of the change in attitude toward the science course was higher; in 4 cases they were the same.

Since the level of significance is affected by the size of the sample, the Concepts of Mathematics levels should be higher than those for Science for the Space Age because of larger enrollments in mathematics (169 vs. 56).

In general, the mean fall responses indicated a less favorable attitude toward the televised courses than toward regular courses. Also, they tended to be more favorable for mathematics than for science, both in the fall and the spring.

In the general evaluation of the course (Items I 1-8) both mathematics and science students indicated a significantly negative change in attitude between fall and spring for one item (1-3), and the mathematics students indicated a negative change in five other items (I-1, 2, 4, 5, and 8).

In Item 5 both groups said that in the spring the televised course was less interesting than their regular subjects. The mathematics students reported that in the spring in their opinion the televised course seemed to be of less value, they

TABLE 13

Comparison Between Mathematics and Science of χ^2 Levels of Significance of Differences Between Fall and Spring Responses in Course Attitude Questionnaire in 1960 - 1961

	Concepts of Mathematics II			Science for the Space Age II			
Item Number	Mean of Spring Responses	χ^2 Level	Direction of Change in Attitude	Mean of Spring Responses	χ^2 Level	Direction of Change in Attitude	Higher Level of Significance
I–1	2.93	1%	↓	3.14	5%	↓	Mathematics
2	2.67	5%	↓	3.34	20%	↓	Mathematics
3	3.09	1%	↓	2.95	5%	↓	Mathematics
4	2.92	1%	↓	3.25	10%	↓	Mathematics
5	1.18	5%	↓	1.14	20%	↑	Mathematics
6	2.94	30%	↓	2.75	50%	↓	Mathematics
7	3.78	50%	↑	3.93	50%	↑	----
8	3.51	5%	↓	3.42	Below 50%	↓	Mathematics
II–1	3.82	50%	↑	2.43	10%	↓	Science
2	2.62	5%	↑	2.30	30%	↑	Mathematics
3	2.77	1%	↓	2.71	20%	↓	Mathematics
4	3.47	30%	↑	3.38	Below 50%	↑	Mathematics
5	2.69	5%	↓	2.47	50%	↓	Mathematics
6	3.27	5%	↑	3.15	Below 50%	↓	Mathematics
7	2.80	30%	↓	2.92	50%	↑	Mathematics
III–1	2.14	1%	↓	2.07	1%	↓	----
2	3.74	1%	↓	3.79	5%	↓	Mathematics
3	2.80	1%	↓	2.42	50%	↑	Mathematics
IV–1	4.16	10%	↓	3.86	30%	↓	Mathematics
2	3.63	1%	↓	4.00	5%	↓	Mathematics
3	2.29	Below 50%	↑	2.23	1%	↓	Science
V–1	3.79	1%	↓	3.29	Below 50%	↓	Mathematics
2	3.40	30%	↓	3.30	Below 50%	↓	Mathematics
3	3.14	Below 50%	↑	3.51	10%	↑	Science
4	2.98	1%	↓	2.90	50%	↓	Mathematics
5	2.67	Below 50%	↓	2.59	Below 50%	↑	----
6	2.62	30%	↓	2.71	Below 50%	↓	Mathematics
7	2.97	20%	↓	2.88	1%	↓	Science
8	1.62	10%	↑	1.44	50%	↑	Mathematics
9	2.82	5%	↑	2.57	Below 50%	↑	Mathematics
10	2.28	50%	↑	2.80	Below 50%	↑	Mathematics
11	1.34	50%	↑	1.39	20%	↑	Science
VI–1	3.43	1%	↓	2.68	5%	↓	Mathematics
2	1.51	1%	n.a.	1.79	5%	n.a.	Mathematics
3	3.18	Below 50%	n.a.	2.16	Below 50%	n.a.	----
4	3.40	20%	n.a.	3.00	Below 50%	n.a.	Mathematics

n.a. indicates not applicable as to direction of change

would have dropped it sooner than in the fall, they were less inclined to recommend it to other students, they were more inclined to choose a conventional classroom course in preference to the televised course, and they would be less inclined to enroll if the course were offered the following year.

In evaluating the difficulty of the course (II 1-7), there were no significant changes in attitude among the Science for the Space Age II students. Among the Concepts of Mathematics II pupils there were changes in attitudes on four items (II-2, 3, 5, and 6).

In response to Item II-2, the mathematics students reported that in the spring they believed the mimeographed achievement tests more difficult than they did the preceding fall. In Item II-6, they stated that they had increased confidence, that they could obtain good grades in the course without a great deal of extra work.

The same group also indicated a decreased tendency to learn as much in the televised courses as in regular mathematics courses (II-3), and less of a tendency to feel the need for concentrated thinking during the televised lectures.

In response to two of the three questions concerning attention during the television classes (Items III 1-3), both groups indicated a decrease in attention as compared with their regular classes and more mind-wandering. The mathematics students also reported increased feeling that time passed slowly during the televised classes.

In the section on application (IV 1-3), both groups indicated that they felt less well prepared in the spring through reading assignments and studying notes for the unit tests than they had been in the fall. The science pupils reported a trend toward doing less of the reading required in the television course.

The next section (V 1-11) sought to collect evidence of the effect of the televised courses on the students' out-of-class interests and activities in comparison with the effect of conventional courses.

There was no significant change in attitude reported in response to seven of the eleven questions. The mathematics group reported a decrease in out-of-class study (V-1), and less thought of the course content outside of the television period (V-4). The science students indicated that their interests in taking additional courses in science had decreased.

The last four questions (VI 1-4) pertained to difficulties caused by television teaching. Both groups reported an increased tendency toward absenteeism for the televised courses (VI-1) and to a greater extent than in the fall gave reasons other than conflict with other classes.

It is interesting to observe that in response to Item VI-3, " Were your television classes supervised while the courses were being televised," the mathematics students had much more supervision than did the science pupils. " All of the time " was reported by 35.5 per cent of the mathematics students and by 16.1 per cent of the science course participants. " Not at all " was indicated by 23.7 per cent for mathematics and 53.6 per cent for science. The more favorable supervision of Concepts of Mathematics II may well have contributed to the increase in preference for this course reported by seven pupils later in this section and to the lower dropout rate reported in Table 48 in this chapter (Hypothesis VI).

The predominantly negative change in attitude is not too strong and might in a large part be due to the lessening of the novelty of televised instruction.

TABLE 14

Distribution of Chi-Square Level of Significance for Each Course in the Six Groupings of Items in the Pupil Attitude Questionnaire in 1960-1961

Questionnaire Section	*Chi-Square Levels of Significance* 1%	5%	10-50%	Below 50%	Totals
I. General Evaluation (8)					
Concepts of Mathematics	3	3	2	—	8
Science for the Space Age	—	1	6	1	8
II. Difficulty of Course (7)					
Concepts of Mathematics	1	3	3	—	7
Science for the Space Age	—	—	5	2	7
III. Pupil Attention (3)					
Concepts of Mathematics	3	—	—	—	3
Science for the Space Age	1	1	1	—	3
IV. Pupil Application (3)					
Concepts of Mathematics	1	—	1	1	3
Science for the Space Age	1	1	1	—	3
V. Independent Work (11)					
Concepts of Mathematics	2	1	6	2	11
Science for the Space Age	1	—	4	6	11
VI. Mechanical Problems (4)					
Concepts of Mathematics	2	—	1	1	4
Science for the Space Age	1	1	—	2	4
Entire Test (36)					
Concepts of Mathematics	12	7	13	4	36
Science for the Space Age	4	4	17	11	36

Table 14 shows that in the questionnaire as a whole and in each of the sections except the one concerned with pupil application, there were more instances of reported change in attitude from fall to spring among the mathematics students than there were among the science pupils.

TABLE 15

Matrices of Responses to Each Item in the Pupil Attitude Questionnaire

Matrix of Question I-1 (Concepts of Mathematics students). "Compared with other courses I am taking this year, the TV course is:

1 — probably the best one I have
2 — one of the better courses, I suppose
3 — about equal in value to my other courses
4 — not quite as good as other courses I am taking
5 — one of the poorest courses I am taking"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	11	5	3	5	1	25
	2	6	26	19	13	—	64
	3	1	8	27	8	3	47
	4	1	1	4	20	—	26
	5	—	—	1	—	6	7
	Totals	19	40	54	46	10	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question I-2 (Concepts of Mathematics students). "If I had a schedule of elective courses and had to drop one of them, I would:

1 — probably drop the televised course last
2 — be inclined to keep this course if I could
3 — find it difficult to choose between dropping the TV course and another regular course
4 — probably drop this course rather than a regular course
5 — drop this course first"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	10	9	1	2	2	24
	2	2	41	9	9	4	65
	3	—	5	6	6	2	19
	4	1	3	9	23	6	42
	5	—	2	—	4	13	19
	Totals	13	60	25	44	27	169

Unfavorable change in attitude significant at 5% level.

Matrix of Question I-3 (Concepts of Mathematics students). "Do you think the course is more or less interesting than regular school courses?

1 — much more interesting
2 — a little more interesting
3 — about the same
4 — a little less interesting
5 — much less interesting"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	14	9	9	8	1	41
	2	3	16	13	12	5	49
	3	2	7	25	7	3	44
	4	—	—	4	14	2	20
	5	—	1	—	5	9	15
	Totals	19	33	51	46	20	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question I-4 (Concepts of Mathematics students). "I would advise my friends to take this TV course:

1 — as one of the best courses they could possibly take
2 — as a better choice than many others they might make
3 — as a choice equal in value to most courses
4 — only with some reservations
5 — only if there were no way to avoid it"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	4	9	4	1	2	20
	2	2	44	11	6	1	64
	3	2	6	21	13	2	44
	4	—	3	4	25	3	35
	5	—	2	1	—	3	6
	Totals	8	64	41	45	11	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question I-5 (Concepts of Mathematics students). "If you could have the same course taught by the same instructor taught in either a conventional classroom or on TV, which would you choose?

1 — the conventional classroom
2 — TV"

		Spring		
	Rating	1	2	Totals
Fall	1	122	4	126
	2	17	26	43
	Totals	139	30	169

Unfavorable change in attitude significant at 5% level.

Matrix of Question I-8 (Concepts of Mathematics students). "If this TV course were to be continued next year with more advanced content, would you:

1 — enroll only as a last resort?
2 — enroll only if no other similar courses were available?
3 — be undecided about enrollment?
4 — enroll if it were convenient?
5 — want very much to enroll?"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	8	—	1	1	1	11
	2	2	8	1	1	—	12
	3	1	3	26	9	2	41
	4	5	2	5	42	4	58
	5	1	2	3	14	27	47
	Totals	17	15	36	67	34	169

Unfavorable change in attitude significant at 5% level.

Matrix of Question II-2 (Concepts of Mathematics students). "The mimeographed achievement tests so far have been:

1 — rather rough
2 — somewhat hard
3 — no more difficult than in regular courses
4 — as easy as could be expected
5 — very easy"

Spring

	Rating	1	2	3	4	5	Totals
Fall	1	17	9	5	1	—	32
	2	3	34	8	5	—	50
	3	2	7	30	2	1	42
	4	1	7	8	13	2	31
	5	—	3	1	5	5	14
	Totals	23	60	52	26	8	169

Favorable change in attitude significant at 5% level.

Matrix of Question II-3 (Concepts of Mathematics students). "Do you think you are learning as much in the TV course as you learn in regular science or math courses?

1 — much less
2 — a little less
3 — about the same
4 — a little more
5 — much more"

Spring

	Rating	1	2	3	4	5	Totals
Fall	1	12	2	—	—	—	14
	2	11	17	3	1	—	32
	3	6	13	35	6	5	65
	4	3	8	7	16	4	38
	5	1	1	2	5	11	20
	Totals	33	41	47	28	20	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question II-5 (Concepts of Mathematics students). "I find during the TV class that:

1 — there does not seem to be anything to warrant real mental effort
2 — I get the material but it doesn't seem to need much thought
3 — I do a fair amount of thinking about the lesson content
4 — I do a great deal of thinking about what the instructor is saying
5 — I am continually absorbed in thinking over what the instructor is saying"

Spring

	Rating	1	2	3	4	5	Totals
Fall	1	10	2	6	—	—	18
	2	3	22	5	—	1	31
	3	4	10	64	3	3	84
	4	1	6	15	7	—	29
	5	1	—	1	2	3	7
	Totals	19	40	91	12	7	169

Unfavorable change in attitude significant at 5% level.

Matrix of Question II-6 (Concepts of Mathematics students). "I could get excellent grades in the course:

1 — with very little effort
2 — without too much work
3 — with a reasonable amount of work
4 — if I put some extra work into it
5 — with a great deal of extra study"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	7	3	2	1	1	14
	2	1	13	5	4	—	23
	3	—	5	49	13	2	69
	4	1	2	5	31	1	40
	5	—	1	2	9	11	23
	Totals	9	24	63	58	15	169

Favorable change in attitude significant at 5% level.

Matrix of Question III-1 (Concepts of Mathematics students). "How does your attention to the TV course compare with your attention in regular class?

1 — much less attention than average
2 — a little poorer attention than average
3 — about the same
4 — a little better attention than average
5 — much better attention than average"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	29	4	1	—	—	34
	2	11	20	5	—	—	36
	3	10	15	25	1	1	52
	4	7	8	2	15	1	33
	5	5	3	1	2	3	14
	Totals	62	50	34	18	5	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question III-2 (Concepts of Mathematics students). "Does your mind wander from the subject during television lessons?

1 — much less
2 — a little less
3 — about the same
4 — a little more
5 — much more than in a regular classroom"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	5	3	—	3	5	16
	2	1	8	8	8	4	29
	3	2	4	24	14	6	50
	4	3	—	3	19	12	37
	5	1	—	1	4	31	37
	Totals	12	15	36	48	58	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question III-3 (Concepts of Mathematics students). " In the television class:

1 — time always passes very quickly
2 — time usually passes very quickly
3 — time sometimes passes very quickly
4 — time usually seems to drag a bit
5 — it seems as if the end of the period will never come "

				Spring			
	Rating	1	2	3	4	5	Totals
Fall	1	24	3	5	5	3	40
	2	7	35	11	6	2	61
	3	2	8	23	5	3	41
	4	—	3	1	15	2	21
	5	—	1	—	1	4	6
	Totals	33	50	40	32	14	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question IV-2 (Concepts of Mathematics students). " How well prepared (reading textbook assignments, studying notes, etc.) do you feel you were for the television course unit tests?

1 — much better prepared than for tests in regular courses
2 — better prepared
3 — about as well prepared
4 — a little less prepared
5 — much less prepared "

				Spring			
	Rating	1	2	3	4	5	Totals
Fall	1	1	1	2	—	2	6
	2	3	6	9	3	1	22
	3	1	5	37	19	6	68
	4	—	—	5	35	7	47
	5	1	1	—	5	19	26
	Totals	6	13	53	62	35	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question V-1 (Concepts of Mathematics students). " How much reading and studying outside of class did you do this year in the area of the subject taught on television?

1 — much more than I would have in a regular class
2 — more
3 — about the same amount
4 — less
5 — much less "

				Spring			
	Rating	1	2	3	4	5	Totals
Fall	1	2	1	1	2	2	8
	2	—	4	3	5	3	15
	3	—	2	24	18	8	52
	4	—	—	4	42	12	58
	5	—	—	—	5	31	36
	Totals	2	7	32	72	56	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question V-4 (Concepts of Mathematics students). "I find myself thinking about the material in the TV course

1 — a great deal
2 — quite often
3 — occasionally
4 — little
5 — hardly at all"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	1	1	1	3	2	8
	2	2	24	21	5	—	52
	3	—	8	51	10	6	75
	4	—	2	3	6	3	14
	5	1	1	1	—	17	20
	Totals	4	36	77	24	28	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question V-9 (Concepts of Mathematics students). "To what extent is the material learned in the TV course u
ful in classwork in other mathematics courses?

1 — not at all
2 — little
3 — to some extent
4 — to a great extent"

		Spring				
	Rating	1	2	3	4	Totals
Fall	1	6	2	3	—	11
	2	1	16	11	5	33
	3	1	2	73	9	85
	4	—	—	3	37	40
	Totals	8	20	90	51	169

Unfavorable change in attitude significant at 5% level.

Matrix of Question VI-1 (Concepts of Mathematics students). "How many times have you attended the television class?

1 — fewer than 50% of the classes
2 — at least 50% of the classes
3 — at least 80% of the classes
4 — all classes except when I was absent from school
5 — every class so far"

		Spring					
	Rating	1	2	3	4	5	Totals
Fall	1	3	—	—	—	—	3
	2	1	—	1	—	—	2
	3	—	1	70	—	—	71
	4	—	—	13	51	—	64
	5	—	—	10	9	10	29
	Totals	4	1	94	60	10	169

Unfavorable change in attitude significant at 1% level.

Matrix of Question VI-2 (Concepts of Mathematics students). “ If you did not attend classes on days when you were the reason was:

0 — no response
1 — conflict with other classes which came during the same period
2 — the rotating schedule of the school
3 — other — please indicate ”

		Spring				
	Rating	0	1	2	3	Totals
F	0	66	3	—	18	87
a	1	—	19	—	2	21
l	2	—	—	6	1	7
l	3	—	2	—	52	54
	Totals	66	24	6	73	169

Change in attitude significant at 1% level.

Matrix of Question I-3 (Science for the Space Age students). “ Do you think the course is more or less interesting ular school courses?

1 — much more interesting
2 — a little more interesting
3 — about the same
4 — a little less interesting
5 — much less interesting ”

		Spring					
	Rating	1	2	3	4	5	Totals
F	1	7	4	—	1	2	14
a	2	2	8	2	4	2	18
	3	1	4	1	2	—	8
l	4	—	—	1	7	—	8
l	5	—	1	—	2	5	8
	Totals	10	17	4	16	9	56

Unfavorable change in attitude significant at 5% level.

Matrix of Question III-1 (Science for the Space Age students). “ How does your attention to the TV course comp your attention in regular class?

1 — much less attention than average
2 — a little poorer attention than average
3 — about the same
4 — a little better attention than average
5 — much better attention than average ”

		Spring					
	Rating	1	2	3	4	5	Totals
F	1	11	—	—	—	—	11
a	2	4	6	1	—	—	11
l	3	4	6	9	1	1	21
	4	1	2	3	1	—	7
l	5	2	1	1	1	1	6
	Totals	22	15	14	3	2	56

Unfavorable change in attitude significant at 1% level.

Matrix of Question III-2 (Science for the Space Age students). "Does your mind wander from the subject during television lessons?

1 — much less
2 — a little less
3 — about the same
4 — a little more
5 — much more than in a regular classroom"

				Spring			
	Rating	1	2	3	4	5	Totals
F	1	1	1	3	1	1	7
a	2	1	2	—	—	2	5
l	3	1	2	10	4	2	19
l	4	—	—	1	8	5	14
	5	—	—	—	—	11	11
	Totals	3	5	14	13	21	56

Unfavorable change in attitude significant at 5% level.

Matrix of Question IV-2 (Science for the Space Age students). "How well prepared (reading textbook assignments, studying notes, etc.) do you feel you were for the television course unit tests?

1 — much better prepared than for tests in regular courses
2 — better prepared
3 — about as well prepared
4 — a little less prepared
5 — much less prepared"

				Spring			
	Rating	1	2	3	4	5	Totals
F	1	—	1	1	—	1	3
a	2	—	—	1	—	3	4
l	3	—	1	13	4	2	20
l	4	—	—	3	7	4	14
	5	—	—	—	2	13	15
	Totals	—	2	18	13	23	56

Unfavorable change in attitude significant at 5% level.

Matrix of Question IV-3 (Science for the Space Age students). "How much of the television course required reading do you do?

1 — very little
2 — about one-quarter
3 — about half
4 — about three-quarters
5 — all, or about all"

				Spring			
	Rating	1	2	3	4	5	Totals
F	1	20	1	—	—	—	21
a	2	1	3	—	—	—	4
l	3	2	3	3	—	—	8
l	4	2	1	2	4	—	9
	5	4	1	3	2	4	14
	Totals	29	9	8	6	4	56

Unfavorable change in attitude significant at 1% level.

Matrix of Question V-7 (Science for the Space Age students). "Since my experience with the TV course:

1 — I want to major in this area
2 — I almost think I might want to major in this area
3 — I want to take more courses in this area but not major
4 — I am not enthusiastic about taking more
5 — I wouldn't take any more of this subject than I had to take"

		Spring					
	Rating	**1**	**2**	**3**	**4**	**5**	**Totals**
Fall	1	9	1	—	1	1	12
	2	1	4	—	—	—	5
	3	—	7	13	3	1	24
	4	—	—	1	9	—	10
	5	—	—	1	—	4	5
	Totals	10	12	15	13	6	56

Favorable change in attitude significant at 1% level.

Matrix of Question VI-1 (Science for the Space Age students). "How many times have you attended the television class?

1 — fewer than 50% of the classes
2 — at least 50% of the classes
3 — at least 80% of the classes
4 — all classes except when I was absent from school
5 — every class so far"

		Spring					
	Rating	**1**	**2**	**3**	**4**	**5**	**Totals**
Fall	1	1	—	—	—	—	1
	2	—	—	—	—	—	—
	3	—	—	26	—	—	26
	4	—	—	6	15	—	21
	5	—	—	5	1	2	8
	Totals	1	—	37	16	2	56

Unfavorable change in attitude significant at 5% level.

Matrix of Question VI-2 (Science for the Space Age students). "If you did not attend TV classes on days when you were in school, the reason was:

0 — no response
1 — conflict with other classes which came during the same period
2 — the rotating schedule of the school
3 — other — please indicate"

		Spring				
	Rating	**0**	**1**	**2**	**3**	**Totals**
Fall	0	14	2	1	8	25
	1	—	7	—	1	8
	2	—	—	7	—	7
	3	—	—	—	16	16
	Totals	14	9	8	25	56

Change in attitude significant at 5% level.

Matrix of Question VI-2 (Science for the Space Age students) shows that there were more instances of failure to attend the television classes on days when the students were in school in the spring than during the fall. This might be due to a change in attitude, but it must be remembered that most of the students were seniors, and there are many more senior class activities in the spring than in the fall.

TABLE 16

Comparison of Favorable Responses of Seven Students Enrolled in Both Televised Courses Toward Each of These Courses

		Distribution of Fall Responses		Distribution of Spring Responses	
Questionnaire Item	Response Checked ¹/	Concepts of Mathematics II	Science for the Space Age II	Concepts of Mathematics II	Science for the Space Age II
I-1	1	2	1	3	—
	2	5	5	3	1
	3	—	1	1	1
	4	—	—	—	3
	5	—	—	—	2
Mean		1.7	2.0	1.7	3.9
I-2	1	4	4	2	1
	2	3	2	5	2
	3	—	1	—	—
	4	—	—	—	1
	5	—	—	—	3
Mean		1.4	1.6	1.7	3.4
I-3	1	5	5	5	1
	2	1	2	1	1
	3	1	—	1	—
	4	—	—	—	2
	5	—	—	—	3
Mean		1.4	1.3	1.4	3.7
I-4	1	5	5	2	—
	2	2	2	5	1
	3	—	—	—	—
	4	—	—	—	5
	5	—	—	—	1
Mean		1.3	1.3	1.7	3.9
I-5	1	4	3	5	5
	2	3	4	2	2
Mean		1.4	1.6	1.3	1.3
Converted Mean		.6	.4	.7	.7
I-6	1	2	2	2	1
	2	2	3	2	1
	3	3	2	3	3
	4	—	—	—	2
	5	—	—	—	—
Mean		2.1	1.7	1.7	2.9
I-7	1	—	—	—	—
	2	1	—	—	1
	3	2	1	2	1
	4	1	1	1	1
	5	3	5	4	4
Mean		3.9	3.9	4.3	4.1
Converted Mean		1.1	1.1	.7	.8
I-8	1	—	—	—	—
	2	—	—	—	2
	3	1	1	—	1
	4	1	1	1	1
	5	5	5	6	3
Mean		4.6	4.6	4.9	3.7
Converted Mean		.4	.4	.1	1.3

TABLE 16 (Continued)

		Distribution of Fall Responses		Distribution of Spring Responses	
Questionnaire Item	Response Checked 1/	Concepts of Mathematics II	Science for the Space Age II	Concepts of Mathematics II	Science for the Space Age II
II-1	1	1	1	—	—
	2	2	3	4	2
	3	2	3	2	2
	4	1	—	—	3
	5	1	—	1	—
Mean		2.9	2.3	2.7	3.1
II-2	1	—	—	—	—
	2	2	3	—	—
	3	2	2	2	4
	4	2	1	4	2
	5	1	1	1	1
Mean		3.3	3.0	3.9	3.6
II-3	1	—	—	—	—
	2	—	—	—	3
	3	—	—	1	3
	4	3	4	3	1
	5	4	3	3	—
Mean		4.6	4.4	4.3	2.7
Converted Mean		.4	.6	.7	2.3
II-4	1	1	2	1	5
	2	2	1	1	—
	3	—	1	1	—
	4	2	1	2	1
	5	2	2	2	1
Mean		3.3	3.0	3.4	2.0
Converted Mean		1.7	2.0	1.6	3.0
II-5	1	1	—	—	2
	2	2	3	—	2
	3	2	2	5	2
	4	1	1	1	1
	5	1	1	1	—
Mean		2.9	3.0	3.4	2.3
Converted Mean		2.1	2.0	1.6	2.7
II-6	1	1	1	—	1
	2	2	1	3	3
	3	1	1	2	1
	4	3	4	2	1
	5	—	—	—	1
Mean		2.9	3.1	2.9	2.7
Converted Mean		2.1	1.9	2.1	2.3
II-7	1	—	—	—	—
	2	2	1	1	2
	3	3	6	3	1
	4	2	—	2	4
	5	—	—	1	—
Mean		3.0	2.9	3.4	3.3
Converted Mean		2.0	2.1	1.6	1.7

TABLE 16 (Continued)

		Distribution of Fall Responses		Distribution of Spring Responses	
Questionnaire Item	Response Checked 1/	Concepts of Mathematics II	Science for the Space Age II	Concepts of Mathematics II	Science for the Space Age II
III-1	1	—	—	—	4
	2	1	1	—	2
	3	3	3	5	1
	4	1	1	1	—
	5	2	2	1	—
Mean		3.6	3.6	3.4	1.6
Converted Mean		1.4	1.4	1.6	3.4
III-2	1	2	2	1	1
	2	2	2	2	—
	3	3	2	4	3
	4	—	1	—	—
	5	—	—	—	3
Mean		2.1	2.3	2.4	3.6
III-3	1	1	1	2	1
	2	4	4	3	2
	3	1	1	—	2
	4	1	1	2	1
	5	—	—	—	1
Mean		2.3	2.3	2.3	2.9
IV-1	1	2	1	—	—
	2	1	2	1	1
	3	2	1	1	3
	4	—	1	1	—
	5	2	2	4	3
Mean		2.9	3.1	4.1	3.7
IV-2	1	1	1	1	—
	2	2	2	1	—
	3	3	2	4	2
	4	1	1	1	1
	5	—	1	—	4
Mean		2.6	2.9	2.7	4.3
IV-3	1	2	2	2	6
	2	1	1	3	—
	3	1	1	—	—
	4	1	1	1	—
	5	2	2	1	1
Mean		3.0	3.0	2.4	1.6
Converted Mean		2.0	2.0	2.6	3.4
V-1	1	—	—	—	1
	2	2	4	1	1
	3	3	1	2	2
	4	2	2	3	3
	5	—	—	1	—
Mean		3.0	2.7	3.6	3.0
V-2	1	—	—	—	—
	2	—	—	—	2
	3	4	3	2	1
	4	2	3	3	2
	5	1	1	2	2
Mean		3.6	3.7	4.0	3.6
Converted Mean		1.4	1.3	1.0	1.4

TABLE 16 (Continued)

		Distribution of Fall Responses		Distribution of Spring Responses	
Questionnaire Item	Response Checked 1/	Concepts of Mathematics II	Science for the Space Age II	Concepts of Mathematics II	Science for the Space Age II
V-3	1	—	—	—	—
	2	—	—	—	1
	3	2	2	3	3
	4	4	4	2	1
	5	1	1	2	2
Mean		3.9	3.9	3.9	3.6
Converted Mean		1.1	1.1	1.1	1.4
V-4	1	1	—	1	—
	2	5	6	1	2
	3	1	1	4	2
	4	—	—	1	1
	5	—	—	—	2
Mean		2.0	2.1	2.7	3.4
V-5	1	1	1	1	—
	2	1	1	1	3
	3	4	5	4	1
	4	1	—	1	1
	5	—	—	—	2
Mean		2.7	2.6	2.7	3.3
V-6	1	3	3	3	1
	2	1	3	1	3
	3	3	1	2	—
	4	—	—	—	2
	5	—	—	1	1
Mean		2.0	1.7	2.3	2.9
V-7	1	6	4	4	3
	2	—	—	—	1
	3	1	2	3	1
	4	—	—	—	1
	5	—	1	—	1
Mean		1.3	2.1	1.9	2.4
V-8	1	5	5	4	3
	2	1	1	2	3
	3	1	1	1	1
	4	—	—	—	—
Mean		1.4	1.4	1.6	1.7
Converted Mean		2.6	2.6	2.4	2.2
V-9	1	—	2	—	2
	2	—	2	—	3
	3	3	—	3	—
	4	4	3	4	2
Mean		3.6	2.6	3.6	2.3
Converted Mean		.4	1.4	.4	1.7
V-10	1	2	1	2	1
	2	2	1	1	3
	3	—	2	3	2
	4	3	3	1	1
Mean		2.6	3.0	2.4	2.4
Converted Mean		1.4	1.0	1.6	1.6

TABLE 16 (Continued)

		Distribution of Fall Responses		Distribution of Spring Responses	
Questionnaire Item	Response Checked [1]	Concepts of Mathematics II	Science for the Space Age II	Concepts of Mathematics II	Science for the Space Age II
V-11	1	6	6	5	5
	2	1	1	1	1
	3	—	—	1	1
	4	—	—	—	—
Mean		1.1	1.1	1.4	1.4
Converted Mean		2.9	2.9	2.6	2.6
VI-1	1	—	—	—	—
	2	—	—	—	—
	3	2	2	4	4
	4	5	5	3	3
	5	—	—	—	—
Mean		3.7	3.7	3.4	3.4
Converted Mean		.3	.3	.6	.6
VI-2	0	5	5	3	3
	1	1	1	2	2
	2	—	—	—	—
	3	1	1	2	2
Mean		.6	.6	1.1	1.1
VI-3	1	2	2	2	2
	2	—	1	—	1
	3	—	1	—	1
	4	4	2	5	3
	5	1	1	—	—
Mean		3.3	2.9	3.1	2.7
Converted Mean		1.7	2.1	1.9	2.3
VI-4	1	1	2	1	2
	2	3	2	2	1
	3	2	3	2	3
	4	1	—	2	1
	5	—	—	—	—
Mean		2.4	2.1	2.7	2.4

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[1] The lower the number of the response the more favorable the attitude toward the televised course. Where the reverse was true, the means have been converted.

TABLE 17

Summary of Relative Liking of Each of the Two Televised Courses in Fall and Spring of 1960-61 by Seven Students Enrolled in Both Courses

Favored Subjects	Number of Test Items Fall	Spring	χ^2
Concepts of Mathematics II	12	26	7.538*
Science for the Space Age II	13	5	12.800*
Equally Favored	11	5	7.200*
Totals	36	36	$\chi^2 = 27.538$**

Table 16 shows the relative liking of the two televised courses in the fall and spring of 1960-61 as expressed by completions of each of the 36 questions by seven pupils who were enrolled in both courses. Table 17 summarizes the data contained in Table 16.

Table 17 indicates that these seven students stated that during the school year they developed a significantly more favorable attitude toward the mathematics course in preference to the science course. This may well be another reason why the dropout rate in Concepts of Mathematics II was less than that in Science for the Space Age II, as reported in Table 48 of this chapter (Hypothesis VI).

It is interesting to observe that the students reported that at the beginning of the year they favored both courses almost exactly equally. This is what one would expect, and it makes the marked change in attitude more credible.

TABLE 18

Comparison of Favorable Responses of the Seven Students in Each of the Six Groupings of Questions

Category	Favored Subject	Number of Test Items Fall	Spring
General Evaluation (8)	Mathematics	2	7
	Science	3	—
	Equally Favored	3	1
Difficulty of Course (7)	Mathematics	3	6
	Science	4	1
	Equally Favored	—	—
Attention (3)	Mathematics	1	3
	Science	—	—
	Equally Favored	2	—
Application (3)	Mathematics	2	2
	Science	—	1
	Equally Favored	1	—
Independent Work (11)	Mathematics	3	7
	Science	5	2
	Equally Favored	3	2
Mechanical Problems (4)	Mathematics	1	1
	Science	1	1
	Equally Favored	2	2

Table 18 is an analysis of Table 16 to ascertain the groupings of questions in which there were changes in attitude toward one televised course in preference to the other.

Because of the small number of cases involved no valid conclusion can be reported.

Six test items for which the statistical significance of the change from fall to spring in Concepts of Mathematics II was at the one per cent level were selected for analysis to discover whether there were significant differences among the four treatment groups. The questions chosen were:

I-1. Compared with other courses I am taking this year, the TV course is:

.... probably the best one I have
.... one of the better courses, I suppose
.... about equal in value to my other courses
.... not quite as good as other courses I am taking
.... one of the poorest courses I am taking

I-3. Do you think the course is more or less interesting than regular school courses?

.... much more interesting
.... a little more interesting
.... about the same
.... a little less interesting
.... much less interesting

II-3. Do you think you are learning as much in the TV course as you learn in regular science or math courses?

.... much less
.... a little less
.... about the same
.... a little more
.... much more

III-1. How does your attention to the TV course compare with your attention in a regular class?

.... much less attention than average
.... a little poorer attention than average
.... about the same
.... a little better attention than average
.... much better attention than average

III-2. Does your mind wander from the subject during television lessons?

.... much less
.... a little less
.... about the same
.... a little more
.... much more than in a regular classroom

V-1. How much reading and study outside of class did you do this year in the area of the subject taught on television?

.... much more than I would have in a regular class
.... more
.... about the same amount
.... less
.... much less

TABLE 19

Significance of Reported Change in Attitudes from Fall to Spring on Six Selected Questions by Students in Each of the Four Treatment Groups in 1960-1961

Questionnaire Item		Number of Questionnaire Responses				
		Total	Television Only	Seminars	Visits	Seminars and Visits
I-1	Number	169	41	41	74	13
	χ^2	28.154	26.901	5.475	6.226	7.738
	Significance Level	1%	1%	10%	10%	1%
I-3	Number	169	41	41	74	13
	χ^2	53.610	23.273	27.278	12.339	1.238
	Significance Level	1%	1%	1%	5%	30%
II-3	Number	169	41	41	74	13
	χ^2	35.934	9.383	16.278	15.054	1.300
	Significance Level	1%	5%	1%	1%	30%
III-1	Number	169	41	41	74	13
	χ^2	47.338	21.489	26.791	11.308	.325
	Significance Level	1%	1%	1%	5%	Below 50%
III-2	Number	169	41	41	74	13
	χ^2	26.868	5.311	12.958	11.581	.325
	Significance Level	1%	20%	1%	5%	Below 50%
V-1	Number	169	41	41	74	13
	χ^2	30.949	9.822	16.873	7.656	11.143
	Significance Level	1%	5%	1%	10%	1%

Since the level of significance is affected by the size of the sample, the Concepts of Mathematics levels should be higher than those for Science for the Space Age because of larger enrollments in mathematics (213 vs. 73). The seminars-and-visits levels should be less often significant than for the other three groups because of the very small enrollment in that group (13 v. 41, 41, 74).

Table 19 indicates that the change in attitude as measured by the six selected test items for each of the four treatment groups was reasonably consistent with the change in attitude of the group as a whole. The two groups with visits varied somewhat more than did the groups with television only and with seminars. All six changes are negative in terms of approval of the televised courses. It might appear that the bi-weekly visits of the assistant teachers tended to reduce the trend in negative attitudes, but there are too many contradictions to permit this conclusion to be drawn safely.

A similar analysis was made for Items II-1 and VI-4, for which the significance of change was at the 50th and 30th per cent level respectively. The purpose was to discover if one or more of the treatment groups had a significant level of change in attitude to questions for which there was no entire-group significant change. The results showed relative consistency among the four groups and the entire group.

TABLE 20

Correlation of Responses of Mathematics and Science Students to Nine Selected Pairs of Student Attitude Questionnaire Items, 1960-1961

Identification Number	Item Number		Item Number	Correlation Coefficient	
				Mathematics	Science
1	I–3		I–6	.47*	.70**
2	II–1		II–4	–.43*	–.39**
3	II–2		II–5	–.06	–.02
4	II–7		VI–1	.06	.24
5	III–1	vs.	VI–3	.12	–.06
6	III–2		III–3	.43**	.16
7	IV–2		IV–3	–.37**	–.58**
8	V–2		VI–4	–.98**	–.34*
9	V–4		V–5	–.04	.27*

* Significant at five per cent level ** Significant at one per cent level

Nine pairs of questions were selected. Correlation coefficients of the responses to each pair were computed for both mathematics and science. Each pair consisted of two questions which would be expected to produce similar responses. The correlation coefficients are contained in Table 20.

Item I-3 refers to the interest of the student in the televised course and I-6 to the usefulness of the information obtained in comparison with the student's regular courses. There seems to be good correlation between interest in the course and a belief that it yields valuable information. This is particularly true of the science students.

There appears to be good correlation between the students' rating of the difficulty of the televised courses (II-1) and its pace (II-4). It seems logical to expect that opinion concerning difficulty would vary directly with opinion concerning pace.

The correlation between high degree of difficulty of the achievement tests (II-2) and need for thinking about what the instructor is saying on television (II-5) is very low.

There seems also to be little relationship between ability to understand clearly at the moment material presented by the television teacher (II-7) and regularity of attendance (VI-1).

The correlation between attention during the televised lessons (III-1) and the amount of teacher supervision of the televised classes (VI-3) was very low. Apparently supervised students estimated the quality of their attention on approximately the same level as did unsupervised pupils.

The relationship between mind-wandering (III-2) and the speed with which time passed (III-3) was close for mathematics students. It was surprisingly lacking among science students.

The negative correlation between how well prepared the students felt for the unit tests (IV-2) and the amount of required reading which they did (IV-3) was to be expected because the responses were scaled inversely.

There was very high correlation between the extent to which mathematics pupils could find independently answers to questions they normally would ask of their teachers (V-2) and lack of concern about not being able to get immediate answers to questions (VI-4). The correlation was lower for the science students.

The relationship between thinking about the material of the televised course a great deal (V-4) and difficulty in remembering the material (V-5) is low.

Generally the correlation between the responses to the nine pairs of questions seemed to be what might logically be expected.

Biographical Aspiration Inventory

In the spring of 1961 two copies of " Questions About You and Your Plans " were completed by the participating students.

The first eight questions sought information concerning the family and social background of the students which might be considered likely to influence their educational and vocational planning. The next six items inquired concerning the high school program of the students and their attitude toward their mathematics and science courses. The last 25 questions were concerned with the educational and vocational plans and aspirations of the students.

The pupils were asked to complete one form on the basis of conditions and attitudes obtaining at the time, and to complete the second form on the basis of their recollections of how they would have answered the same questions the preceding September.

One purpose for using the questionnaire was to obtain additional information about the students; a second purpose was to learn if significant differences in their vocational and educational aspirations had occurred during the year they were enrolled in the Nine O'Clock Scholar Program.

TABLE 21

Number, Relative Age, and College Experience of Siblings of Participating Students in 1960-1961

Number of Siblings Reported	Number of Pupils Responding	Number of Older Siblings	Number of Pupils Responding		Number of Siblings Attending (or Have Attended) College	Number of Pupils Responding	
0	21	0	113		0	152	
1	71	1	64		1	52	
2	55	2	24		2	9	
3	24	3	14		3	4	
4	24	4	—	Mn = 1.7	4	2	Mn = 1.3
5–6	15	5–6	2		5–6	—	
7–8	4	7–8	1		7–8	—	
9 or more	5	9 or more	1		9 or more	—	
	219		219			219	

Table 21 shows that the mean number of siblings reported for the 219 students was 2.3.

Only 21 (9.6 per cent) of the students had no siblings. A total of 113 had no older siblings. Eliminating the 21 who had no brothers or sisters, 92 (41.6 per cent) were the eldest of two or more children in their families. Sixty-seven of the pupils had brothers or sisters who were attending or had attended college.

Since these students were in the senior high school their families were likely to be complete and more of them would be expected to have siblings than if this were an elementary-school sample. Of the 198 with siblings, 92 were the eldest child, leaving only 106 to be a mid-child or the youngest; this is probably because of the increasing number of families and the decreasing age of parents.

TABLE 22

Relationship between Number of Older Siblings and Number of Siblings in College or Who Had Attended College

	Number of Students Responding		
Number of Older Siblings	Older Siblings in College	Older Siblings Not in College	Totals
1	52	12	64
2	9	15	24
More than 2	6	12	18
Totals	67	39	106

Table 22 suggests a relationship between the number of older brothers and sisters and the number who had had college experience. These data tend to indicate that with only one older sibling there was greater likelihood that he would have entered college than if there were two or more.

Consequently, it may be said that while a wide range of differences occurred, most of the pupils were members of multiple-child families, and the pupils tended to have more younger than older siblings. Of the 106 with older siblings, 67 had one or more siblings in college. This suggests " college-going " families, and their children were selected for the television courses for high ability — suggesting that they averaged higher in ability than their brothers and sisters by the Law of Regression. It would seem, consequently, that a very high proportion of these students would be likely to go to college.

The fourth question elicited the information that 199 of the students had both parents living; 2 had only a mother living; 3 only a father; and 4 had neither living. Nine pupils did not answer this question. Since the percentage of response listing both parents as living was so high (94.7 per cent), no table of these data was constructed.

TABLE 23

Formal Education, Occupational Status, and Occupational Need for Mathematics and Science of Fathers of Participating Students, 1960-1961

Education	Number of Responses	Occupational Classification	Number of Responses	Type of Occupation	Number of Responses	Level of Math or Science Used by Father	Number of Responses
Some Grade School	12	Forestry, Mining	5	Professional — High Income	22	High School Math & Science	32
Completed Grade 8	25	Agriculture	23	Professional — Low Income	15	High School Mathematics	127
Some High School	27	Fisheries	6	Managerial — High Income	9	High School Science	6
Completed High School	82	Manufacturing	49	Managerial — Low Income	25	More than High School Math & Science	24
Some College	20	Transportation, Communications, Public Utilities	5	Clerical, Sales, Skilled Trades	90	Job Chiefly Math & Science	13
Bachelor's Degree	22	Wholesale or Retail Trade	38	Semi-skilled & Unskilled Labor	23	Job Chiefly Mathematics	2
Graduate Study	25	Finance, Insurance, Real Estate	8	Farmer	21	Job Chiefly Science	9
Unknown	5	Contract Construction	20	Fisherman	3	No Response	6
No Response	1	Government Service	56	Forestry Work	5		
		No Response	9	No Response	6		
	219		219		219		219

The average educational and job level of the fathers of these students probably is greater than that of most Maine fathers in the same age group. The average need for mathematics and science also seems higher than usual.

TABLE 24

College Plans of the " Friend You Like Most " of 1960-1961 Participating Students

Spring Responses

Response	Frequency
Definitely Planning to Attend College or Is Already in College	130
Thinking About College and Probably Will Attend	38
Thinking about College but Probably Will Not Go	6
Not Planning to Attend College	28
Do Not Know	1
	203

Table 24 shows that the closest friend of more than three-fourths of the students in the Nine O-Clock Scholar Program had indicated to these students strong college aspirations. A comparison with the responses for the preceding spring showed that little change had occurred during the year and no trend was evident. The college goals of these students and their friends may be related to other conditions that cause the friendship. It would seem fair to assume that the aspirations of the students and their friends would interact in maintaining favorable attitudes toward further education.

TABLE 25

College Plans of Contemporaries of Participating Students With Whom They Spent Most of Their Free Time

Spring Responses		Reported Fall Opinion	
Response	Frequency	Comparative Response	Frequency
None Had Plans	5	Less Interest in College	11
Only a Few	43	No Change	201
Most of Them	146	More Interest in College	5
All of Them	25	No Response	2
	219	$\chi^2 = 2.250$	219

Table 25 reveals that these students spent their free time chiefly in the company of boys and girls their own age who for the most part planned to attend college. The answers to the questionnaires do not show any significant differences between fall and spring in the plans of their friends.

TABLE 26

Secondary-School Grades Earned by 1960-1961 Students

Spring Responses		Reported Fall Opinion	
Response	Frequency	Comparative Response	Frequency
In the Top Quarter of His Class	169	In Higher Quarter than in Spring	5
In the Second Quarter	34	No Change	204
In the Third Quarter	13	In Lower Quarter than in Spring	6
In the Lowest Quarter	0		
		No Response	4
No Response	3		
	219	$\chi^2 = .091$	219

Table 26 shows that 169 pupils (77 per cent) reported that their secondary-school grades were in the top quartile of their classes. Six per cent (13 students) declared that their grades were in the third quartile. These data represented little change from the preceding fall.

Question 10 elicited the information that 206 (95.4 per cent) of the 216 pupils who answered the question were enrolled in the college preparatory course, 3 in the commercial course, and 7 in a vocational shop program.

These data provide additional evidence that these pupils were a select group scholastically, but that some were allowed to participate for special reasons.

TABLE 27

Number of Semesters of Algebra, Geometry, Trigonometry and Calculus 1960-1961 Students Reported They Would Have Completed in Grades 9-12

Number of Semesters	Frequency
3 or less	—
4 or 5	9
6 or 7	31
8 or 9	105
10 or 11	62
12 or more	12
No response	—
Mean = 8.84	219

TABLE 28

Preference of 1960-1961 Students for Fewer, About the Same, or More College Preparatory Mathematics Courses

Spring Responses		Reported Fall Opinion	
Response	Frequency	Comparative Response	Frequency
Fewer	9	Preferred Fewer than in Spring	9
About the Same	105	No Change	201
More	105	Preferred More than in Spring	9
	219	$\chi^2 = .0388$	219

Tables 27 and 28 reveal that a very large number of the participating students (81.7 per cent) will have had 8 or more semesters — about as much as was available to them—of college preparatory mathematics before graduation from high school, and that almost all of them felt that it was desirable to have at least this much mathematics. The students indicated that during 1960-1961 there had been no measurable change in their attitudes toward the amount of mathematics they would like to have in their secondary-school programs.

TABLE 29

Relationship between Quartile Level of High School Grades and Satisfaction with Amount of Mathematics in High School Program

	Preference of Students for Fewer, About the Same, or More Courses in Mathematics			
Quartile Level of School Grades	1	2	3	Totals
1	8	82	79	169
2	1	16	17	34
3	—	5	8	13
Unknown	—	2	1	3
Totals	9	105	105	219

$r = .156$

Table 29 indicates that there was no significant correlation between the number of mathematics courses taken by the students in grades 9-12 and their quartile grade placement.

TABLE 30

Number of Semesters of Biology, Chemistry, and Physics 1960-1961 Students Reported They Would Have Completed in Grades 9-12

Numbers of Semesters	Frequency
1	1
2 or 3	7
4 or 5	47
6 or 7	100
8 or 9	50
10 or 11	14
12 or more	7
Mean = 6.81	226

TABLE 31

Preferences of 1960-1961 Students for Fewer, About the Same, or More College Preparatory Science Courses

Spring Response		Reported Fall Opinion	
Response	Frequency	Comparative Response	Frequency
Fewer	12	Preferred Fewer	15
About the Same	91	No Change	195
More	116	Preferred More than in Spring	8
No Response	—	No Response	1
	219	$\chi = 2.1304$	219

Tables 30 and 31 indicate that 71 (32.4 per cent) of the 219 students will have had 8 or more semesters of college preparatory science courses in high school, and that almost all of them indicated that they believed they should have at least this much science. No significant change in attitude was reported during the year.

A comparison of the data contained in Tables 28 and 30 reveals that these students will have had more mathematics than science in their high school programs.

TABLE 32

Extent to Which 1960-1961 Students Reported They Had Discussed Going to College with School Personnel and with Their Parents

With Teachers or Guidance Counselors				With Parents or Guardians			
Spring Responses		Reported Fall Opinion		Spring Responses		Reported Fall Opinion	
Response	Frequency	Comparative Response	Frequency	Response	Frequency	Comparative Response	Frequency
Not at All	16	Less than Spring	52	Not at All	3	Less than Spring	40
Some	15	No Change	164	Some	55	No Change	178
Quite a Lot	188	More than Spring	2	Quite a Lot	161	More than Spring	—
No Response	—	No Response	1	No Response	—	No Response	1
	219	$\chi^2 = 46.2962^{**}$	219		219	$\chi^2 = 40.0000^{**}$	219

Table 32 shows that during the school year a significantly larger number of students began to discuss going to college with both their parents and their teachers and guidance counselors. Part of the reason for this may be due to the fact that 74 per cent of these students were in grade 12.

TABLE 33

Vocational Aspirations of 1960-1961 Students Fifteen Years Hence

Spring Responses	Frequency	Reported Fall Opinion	Frequency
Professional; High Education; High Income (Doctor, Dentist, Lawyer)	104	No Change in Education or Income	159
Teacher, Minister; High Education; Low Income	64	More Education; Higher Income	5
Managerial-Executive; Moderate Education; High Income	11	More Education; Income About the Same	4
Low Managerial; Moderate Education; Moderate Income	9	More Education; Less Income	1
Clerical, Sales, Service, Skilled Labor; High School Education; Moderate Income	12	No Change in Education; Higher Income	6
Unskilled Labor; Less Education; Low Income; Farming, Fishing, Forestry, Small Farmer, Independent Fisherman; Etc.	2	Less Education; Income Unchanged	—
No Response	17	No Change in Education; Less Income	4
		Less Education; Higher Income	—
		Less Education; Less Income	3
		No Response	37
	219		219

Table 33 reveals that 104 of the 219 students were interested in the spring of 1961 in professional work with high income, 64 would like to enter lower-paying professions which required extensive education, and 11 wanted executive-type jobs with high income. A total of 159 pupils indicated that their aspirations had not changed since the preceding fall.

Of those who showed a changed response by spring, 10 had wanted more education, 10 about the same, and 3 had wanted less. Examining the same 23 responses with respect to expected income, 11 had wanted higher income, 4 wanted about the same, and 8 had wanted less income. In neither respect did the changes seem to be important.

TABLE 34

Amount of Mathematics and Science Required for Occupations for Which Students Expressed Preference in Spring of 1961 Compared with Their Fall Preference

Response	Frequency	Response	Frequency
Requires Less Mathematics	8	Requires Less Science	6
Requires Same Amount of Mathematics	162	Requires Same Amount of Science	162
Requires More Mathematics	12	Requires More Science	14
No Response	37	No Response	37
	219		219

Table 34 shows that during the year 1960-1961 the students as a group did not report a change in occupational preference that would require significantly more or less mathematics or science.

Generally, these students were enrolled in programs of study which included a strong program in science and especially in mathematics, they were interested in occupations which required advanced education, and their occupational interests remained relatively stable during the school year.

TABLE 35

Comparative Aspirations of Students for College Attendance and What They Said They Probably Would Do after High School Graduation

	What the Students Said They Would Like to Do After High School Graduation		What the Students Said They Thought They Would Do After High School Graduation	
Response	Spring Frequency	Change from Fall Frequency	Spring Frequency	Change from Fall Frequency
Go to College	170	9	158	11
Get a Part-Time Job and Go to College	19	3	25	6
Get a Full-Time Job and Go to College at Night	3	n.a.	1	n.a.
Work for a Year or Two and then Go to College	9	n.a.	12	1
Go to a Trade or Other Specialized School	8	4	8	5
Become an Apprentice	—	n.a.	2	n.a.
Get a Job	3	2	5	1
Other	7	n.a.	7	n.a.
No Response	—	1	1	1
Same Response as in Spring		200		194
	219	219	219	219

n.a. indicates not applicable

As would be expected, Table 35 shows that a few more pupils expected to work either before or in conjunction with college attendance than they would prefer. Also, the table indicates that the number of pupils who changed their college desires or expectations during the school year was small. However, while the change is not significant, the 9 and 11 pupils respectively who indicated a change to " Go to College " in what they would like to do and in what they thought they would do are the largest frequencies of change and are in the category which already was the largest and most favorable.

TABLE 36

Comparative Willingness of the Students in the Spring of 1961 to Accept Scholarships to Study in Selected Areas

Response	Engineering	Mathematics	Physical Sciences	Education	Humanities	Biological Sciences	Social Sciences	Business	Fine Arts	Agriculture
Would Certainly Accept	92	87	70	49	46	31	30	27	19	13
Would Probably Accept	30	49	47	45	38	35	39	33	14	17
Might Accept	27	44	44	59	41	72	47	48	29	24
Would Probably Not Accept	24	22	25	39	49	49	61	57	46	51
Would Certainly Not Accept	46	16	33	27	45	31	41	54	111	113
No Response	—	1	—	—	—	1	1	—	—	1
Totals	219	219	219	219	219	219	219	219	219	219

Table 36 shows that more pupils stated that they would certainly accept a scholarship to study engineering than any other of the ten areas, with mathematics a close second, and physical sciences third. More pupils indicated they would certainly not accept a scholarship to study agriculture or fine arts than in any other areas.

The response to engineering is definitely bimodal. Physical sciences and the humanities suggest bimodality.

TABLE 37

Comparison of Fall and Spring Indication of Student Willingness to Accept Scholarships in Ten Selected Areas

Response	Engineering	Mathematics	Physical Sciences	Education	Humanities	Biological Sciences	Social Sciences	Business	Fine Arts	Agriculture
More Willing to Accept Scholarship than in Spring	21	18	17	22	18	26	21	21	14	16
No Change in Attitude	181	184	171	166	165	158	160	166	184	191
Less Willing to Accept Scholarship than in Spring	16	15	30	30	34	33	36	31	20	10
No Response	1	2	1	1	2	2	2	1	1	2
Totals	219	219	219	219	219	219	219	219	219	219
χ^2	.67576	.2728	3.5957	1.2308	4.9230*	.8305	3.9474*	1.9230	1.0588	1.3846

Table 37 shows that the pupils indicated no significant change between fall and spring in their attitudes toward accepting scholarships to study engineering, mathematics, physical sciences, education, biological sciences, business, fine arts, or agriculture. It seems reasonable to assert that the high esteem with which they regarded mathematics at the beginning of the year was not affected materially by their experiences during the year. Conversely, the disinterest in fine arts and agriculture was unaffected by their experiences during the year.

There was significant change in the pupils' attitudes toward college study in social sciences and the humanities. There was a lessening of interest in engineering, and an increase of interest reported in physical sciences and the humanities.

TABLE 38

Reasons Checked by Students for Wanting to Attend College

	Spring Responses		Fall Responses Different from Responses the Next Spring	
Response	Most Important Reason	Other Important Reasons[1]/	Most Important Reason	Other Important Reasons[1]/
I do not want to go to college	3	4	—	4
A college degree is necessary for the kind of work I want to do	105	55	7	12
College graduates earn more money	31	112	4	14
I enjoy studying and want to continue academic work	28	39	5	15
I want to explore several lines of work to see what I am most interested in	17	28	1	10
I like the idea of being a college graduate	6	20	—	15
My parents insist upon my going to college	4	23	1	5
It will help me make good business contacts	2	3	—	4
I want the close fellowship of living with other students on campus	1	18	2	7
College will be a good place to meet the kind of person I would like to marry	—	9	—	3
There is not much for me to do around home	1	4	—	2
My teachers urge me to go to college	—	23	1	10
Business, church, or community leaders tell me I should go to college	1	2	—	4
I want to get into college athletics	1	13	1	5
It has always been expected that I would go to college	1	16	2	9
Most of my friends are going to college	—	11	2	6
College life will help me to develop socially	1	14	—	7
It will be fun to go to college	1	7	1	4
Other	5	9	1	5
No response to question	11	28	191[2]/	297[2]/

[1]/ The second and third reasons checked by students are combined in this column.
[2]/ Includes same response as in spring.

Table 38 shows that the most frequently given reason for wanting to attend college was the realization that a college degree was necessary to permit the students to do the kind of work they wanted to do. Money and enjoyment of study were the second and third most frequent for the "Most Important Reason" and also as secondary reasons, and the desire to explore several lines of work was next in each case. Responses indicating other reasons for wanting to go to college were scattered.

The table also indicates that the students' reasons in the spring of 1961 for wanting to attend college differed little from their reasons the preceding fall.

TABLE 39

Probable Reasons Selected by Students for Failure to Attend College if They Do Not Do So

Response	Spring Responses	Fall Responses Different from Responses the Next Spring
It would cost more than my family can afford	116	17
I have never thought about why I might not go to college	45	7
I am not sure I want to go	25	27
My high school grades are too low	21	8
I don't think I have the ability	19	31
I would rather get married	17	114
I want (or need) to start earning a living as soon as possible	13	11
A college education would not help me to do the things that I am most interested in	8	6
It would cost more than it is worth	6	20
My teachers think I should not go	2	15
It is more work than it is worth	2	8
My family does not want me to go	1	3
Most people I know (my family and friends) do not go to college	1	3
I have never thought about going to college	1	3
Other	32	41
No response or no second or third response	352	406
Totals	661[1]/	720[2]/

[1]/ The total number of pupils was 219. However, some pupils circled as many as four responses in the spring and five in the fall.

[2]/ The students obviously circled more responses in the fall than in the spring.

Table 39 shows that the students indicated a belief that the financial limitations of their families was the most frequent reason why they might not be able to attend college. In the spring of 1961, however, there were 17 fewer pupils advancing this reason than in the preceding fall. It is interesting to observe that in the spring, 45 students said that they had never thought about why they might not go to college, seven fewer than the preceding fall.

In the spring responses, 25 pupils said they were not sure that they wanted to go, 19 that they did not think they had the ability, 17 that they would rather get married, and 13 that they wanted or needed to start earning a living as soon as possible.

The greatest change between fall and spring responses was in the number of pupils who said " I would rather get married." In the fall response 131 pupils gave this as a reason; in the spring the number was reduced to 17. It is possible only to speculate concerning the reasons for this change—closer proximity to college entrance, increased maturity, sharper realization of the need for a college education, greater publicity to loan and scholarship programs, and many other possible reasons.

TABLE 40

Choice of College Areas of Study by 1960-1961 Students

Response	Spring Responses		Fall Responses Different from Responses the Next Spring	
	First Choice	Two Additional Choices	First Choice	Two Additional Choices
Engineering	46	24	10	5
Physical Science	29	23	4	6
Mathematics	27	31	4	8
Humanities	16	3	4	2
Pre-medicine, Pre-dentistry, Nursing	14	4	1	5
Business	10	12	1	5
Education	10	9	—	3
Fine Arts	7	2	—	1
Biological Sciences	6	3	2	2
Coaching or Physical Education	5	4	2	—
Social Sciences (Sociology, Anthropology, Economics)	5	2	1	2
History	3	9	—	4
Agriculture	3	5	—	2
Home Economics	3	3	—	2
Pre-law	3	3	—	—
Psychology	2	8	1	2
Accounting	2	5	—	2
Public Administration	—	2	1	1
Other	5	1	1	—
I have no plans and cannot say	1	13	1	8
No response	22	272	186[1]/	378[1]/
Totals	219	438	219	438

[1]/ Includes same response as in spring.

In answering the question for which Table 40 was prepared, the students were asked to encircle the number preceding the area in which they probably would study if they did go to college. They were then asked to blacken this circle if this were the area in which they were most interested in studying. If it were not, they were asked to circle the number before the area which they would like to study. A third circle was also drawn by 52 pupils. The students were prepared by the instructions for previous questions to circle three items.

Table 20 shows that 154 of the 219 students gave the same response to this question for both fall and spring opinions, thus indicating that the college program which they reported they would like to follow and the program which they would prefer to follow remained unchanged.

Engineering, physical science, and mathematics again were reported as the most numerous choices. It also seems significant that a relatively large number of pupils placed unblackened circles before these items, thus indicating some conflict between what they would really like to study and what they said they probably would study.

Except for these three areas, there was little change in reported opinion between fall and spring.

TABLE 41

The Most Important Factors Reported in College Selection

Response	Spring Responses First Choice	Spring Responses Two Additional Choices	Fall Responses Different from Responses the Next Spring First Choice	Fall Responses Different from Responses the Next Spring Two Additional Choices
Cost	64	68	7	18
Excellence of training in field I am interested in	49	53	6	17
Academic reputation of the college	34	53	8	16
I can meet the admissions requirements	12	21	4	5
Nearness to home	5	41	1	11
The school will give me a scholarship	5	15	1	2
Religious reasons or affiliation	3	8	2	3
Size of college	1	33	—	9
Strong student employment program	1	16	—	2
Athletic program	1	9	—	6
Family preference	1	9	1	2
The school's graduates can make good contacts	1	7	—	4
Location in relation to other schools, big cities, climate, etc.	—	8	—	8
Whether co-educational or not	—	8	—	2
Students have a pleasant social life there	—	3	1	2
My high school faculty recommends it	—	5	1	5
My friends will go there	—	3	1	2
Other	3	3	—	2
I do not plan to go	1	14	—	5
No response	38	61	186[1]	317[1]
Totals	219	438	219	438

[1] Includes same response as in spring.

Table 41 indicates that the students reported that cost, the expectation of excellence of training in the fields in which they were interested, and the overall academic reputation of the college were the most important factors in choosing a college. As secondary or tertiary factors, the pupils mentioned with relative frequency not only these three reasons but also nearness to home, ability to meet the entrance requirements, and the size of the college.

Such factors as family preference, the ability of the school's graduates to make good contacts, the location of the college, whether it is coeducational or not, the quality of the school's social life, the opinion of his high school teachers, and whether or not his friends would go there were reported only infrequently as being important.

Between fall and spring there was some reduction in the frequency with which cost, excellence of training in the field in which the students were interested, and the academic reputation of the college were reported to be important.

It would appear that these students were serious, relatively mature in their approach to choosing a college, and relatively not influenced greatly by the opinions of their home or their school.

TABLE 42

Number of Students Who Indicated that They Were Familiar with Selected Scholarship Programs

Scholarship Program	Yes	No
Navy ROTC	100	119
Seven College Scholarship Program for Women	6	213
Westinghouse Science Talent Search	77	142
National or regional scholarships offered by Harvard, Yale, or Princeton	33	186
Local industrial scholarships for which you are eligible	58	161
Scholarships offered by your state, your state university, or other colleges within the state	146	73
Special scholarships available only to graduates of your high school	103	116

This sample contains somewhat more than twice as many boys as girls.

It would appear that a surprising number of the students were lacking comprehensive information concerning the availability of scholarship opportunities. This seems unfortunate particularly because financial inadequacies have been reported by the students as an important factor both in deciding whether to try to go to college and in selecting a college.

TABLE 43

Expected Source of Funds to Support Their College Education

			Percentage				No	
Question	0	10	25	50	75	100	Response	Totals
Per cent family expected to pay	31	27	43	44	30	14	30	219
Per cent summer earnings and part-time jobs expected to pay	15	37	73	37	21	4	32	219
Per cent expected from scholarships	62	31	42	31	9	2	42	219
Per cent government expected to pay (e. g. ROTC, Service academies)	144	6	5	1	4	4	55	219
Per cent students expect they will need to borrow	90	27	40	9	6	2	45	219

Table 43 shows that these students expect that their families will assist them financially to attend college, but the majority expect less than half of their expenses to be defrayed by these means. The pupils also indicated that generally they believed they would earn less than half of what they would need.

More than half of the students expressed the belief that they would receive some scholarship aid, but 62 did not expect any. Generally, scholarships did not play a very strong role in their reported college plans, and this may be due in part to the lack of knowledge of scholarship potentials expressed in the preceding table.

There was an almost equal division between those who said they did expect to borrow money and those who said they did not. Generally, those who expected to borrow, indicated that they believed it necessary to obtain 25 to 50 per cent of the money in this way. These responses suggest a generally realistic understanding of the problem of financing a college education.

An analysis of the fall response to these questions indicated that 144 of the 219 students gave the same response as they did the following spring. Twelve students had different answers to all five questions, 5 to four items, 20 to three, 17 to two, and 21 to only one. It would seem that a change by 75 students in their expected means of financing a college education is a substantial one.

Facts About Science (FAS)

The Facts About Science Test is an experimental instrument designed to measure the extent to which students perceive the implications of science facts and techniques rather than to measure the quantity of substantive learning.

Scale 1 consists of items related to understandings of science as an institution and Scale 2 to knowledge of scientists as an occupational group.

TABLE 44

Gain between Fall and Spring in Facts About Science Test by Treatment Groups and by Total Group of Science for the Space Age I Students

		Treatment Group					
Scale	Data Reported	Television Only	Seminars	Visits	Seminars and Visits	Total Group	F-ratio
	Number of Pupils	57	28	83	26	194	
Scale 1	Fall Mean Score	28.9474	27.7500	28.0602	29.5385	28.5740	
	Actual Mean Gain	1.3333	1.6785	1.3614	–.4231	1.1598	
	Adjusted Mean Gain	1.2002	1.6294	1.3214	–.4723	——	1.273
	S. D. (Spring Mean Score)	3.1363	3.0712	2.9230	2.8578	3.0663	
Scale 2	Fall Mean Score	29.2105	27.8214	27.6506	29.5000	28.5456	
	Actual Mean Gain	1.6140	3.6429	2.3735	.4231	2.0721	
	Adjusted Mean Gain	1.4976	3.4605	2.2656	.2408	——	2.543
	S. D. (Spring Mean Score)	2.8455	3.6077	3.5183	3.8648	3.5180	

N.B. The maximum score on Scale 1 is 38; on Scale 2, 40.

TABLE 45

Gain between Fall and Spring in Facts About Science Test by Treatment Groups and by Total Group of Science for the Space Age II Students

		Treatment Group					
Scale	Data Reported	Television Only	Seminars	Visits	Seminars and Visits	Total Group	F-ratio
	Number of Pupils	10	12	29	11	62	
Scale 1	Fall Mean Score	27.6000	29.0000	26.7586	28.8181	28.0442	
	Actual Mean Gain	– .2000	.6666	.6896	.6363	.5323	
	Adjusted Mean Gain	– .1051	.6599	.8933	.6296	——	.163
	S. D. (Spring Mean Score)	4.8744	3.8152	4.5037	2.3461	4.1493	
Scale 2	Fall Mean Score	29.4000	28.3846	27.3103	29.6363	28.6828	
	Actual Mean Gain	– 1.3000	1.6666	1.4827	1.8182	1.1290	
	Adjusted Mean Gain	– 1.4287	1.9556	1.6128	2.1071	——	1.452
	S. D. (Spring Mean Score)	5.7974	2.4267	3.9271	3.3253	4.1093	

Tables 44 and 45 show that in both years there was a gain in scores between fall and the following spring, but the increase in scores was modest. The first-year students showed a somewhat larger increase on both scales than did the second-year group. Both groups consistently showed greater growth in knowledge of scientists as an occupational group than in understanding of science as an institution.

The variations among treatment groups, as measured by analysis of covariance, were not significant, and there was no consistent trend.

The growth in understanding of science as an institution and in knowledge of scientists did not vary significantly with the amount of supplementary services given the students. The TV-only group did about as well as those with additional service from staff members.

Because of the high mean fall scores on this test, it is not surprising that the gain in the spring test scores was small. The small gain may be attributed in part to an additional year of maturity, the overall effect of the televised courses, and to the related courses which the pupils were taking concurrently. For these reasons it is not surprising that the differential treatment of the subgroups did not produce significant results.

Summary

The data obtained in the four questionnaires show that as a group the pupils participating in the televised courses were good students and had formulated relatively stable educational and vocational plans. They were taking about all the college preparatory science and mathematics courses offered in their schools. They wanted to attend college and enroll in engineering, physical science and mathematics.

The questionnaires indicate that during the year the pupils' educational and vocational aspirations and plans did not change substantially. Their attitudes toward the subject areas represented by the televised courses already were favorable when they enrolled. The small amount of change that was evident was generally favorable to mathematics and science.

Because of the specialized nature of the student group, there probably is insufficient evidence of change to warrant a categorical statement that the fourth hypothesis has been proved to be valid. Nevertheless, the evidence does suggest that the students were affected favorably.

FIFTH HYPOTHESIS

Interest and enthusiasm of the school's personnel have a more significant effect in stimulating high pupil achievement and interest than does direct assistance with course content.

The interest and enthusiasm of school personnel is difficult to evaluate. In order to obtain a numerical score to use in testing the data, all project personnel and other persons in the State Department of Education were asked to evaluate on a five-point scale the " interest and enthusiasm " of personnel of participating schools whom they believed they had had sufficient opportunity to observe and judge.

In the analyses of covariance performed in this study all computations were made in terms of treatment groups. In these analyses the school personnel interest and enthusiasm mean score was used as one of the control variables. A sophisticated analysis of the data by schools instead of by treatment groups was not attempted.

The project staff did not have a satisfactory method of evaluating the attitude toward the televised courses of administrators and teachers in the participating schools. The opportunity to judge these attitudes varied in proportion to the amount of service provided by the project teachers in the four treatment groups. Also, it should be pointed out that the correlation computations by treatment groups instead of by schools results in some equalization of the attitude ratings of the schools within each group.

Considering the few schools in each treatment group and the sparcity and subjectivity of the information used to rate the schools, it is not surprising that Table 46 contains both positive and negative coefficients and no consistent trends. Because of the data in this table and its nature, no sophisticated analysis of this variable was attempted. Nevertheless, it is the firm conviction of the project personnel that the day-by-day attitude of the local teachers and administrators did have a large effect on student achievement.

SIXTH HYPOTHESIS

Variations in the amount of supplementary assistance, grade level, sex, previous or concurrent related courses, general knowledge of the subject area, academic aptitude, and success on first unit tests significantly affect the dropout rate of pupils.

For the purposes of this part of the study a " dropout " was defined as a student who was enrolled, took the fall SCAT, respective STEP, and FAS tests, and discontinued the course after October 23, 1959, or October 25, 1960. These dates were the latest ones on which the three tests listed above could be mailed for machine scoring. The 38 pupils whose names were registered by their schools for participation but who failed to take any of the tests were not considered dropouts, but rather " non-starters." This reduced the total number of dropouts from 251 to 213.

TABLE 46

Correlation between Interest and Enthusiasm Ratings and Mean Scores on Staff-Constructed Achievement Tests for Nine O'Clock Scholar Students

Course	Test	TV-Only			Seminars			Visits			Seminars and Visits			Total Group		
		No. Schools	No. Pupils	r	No. Schools	No. Pupils	r	No. Schools	No. Pupils	r	No. Schools	No. Pupils	r	No. Schools	No. Pupils	r
Concepts of Mathematics I		26	109		7	17		21	71		7	37		54	234	
	End-of-Course Test			.04			.07			.61			.37*			.02
	Unit Test—Logic and Sets			–.11			–.14			.47			–.12			–.07
	Unit Test—Number Theory			–.12			.15			.49			.30			–.05
	Unit Test—Probability and Statistics			–.11			–.22			.45			.53*			–.02
Concepts of Mathematics II		23	67		11	40		21	90		4	16		50	213	
	End-of-Course Test			–.01			–.44*			.05			–.08			–.06
	Unit Test—Trigonometry			–.10			–.55*			.02			.09			–.03
	Unit Test—Matrix Algebra			–.06			–.20			.04			–.06			–.08
	Unit Test—Set Theory			.11			.07			–.11			–.08			–.05
Science for the Space Age I		20	59		6	29		22	88		4	27		45	203	
	End-of-Course Test			.29*			.05			.05			.27			.14
	Unit Test—Geology and Earth Science			.19			–.05			–.04			.51*			.10
	Unit Test—Chemistry			.29*			.35			–.02			.39*			.17
	Unit Test—Biology			.24			.13			.02			.05			.10
Science for the Space Age II		5	12		8	13		14	36		5	14		26	75	
	End-of-Course Test			–.22			.21			–.32*			–.46			–.16
	Unit Test—Astronomy			.05			–.23			–.40*			–.51			–.25*
	Unit Test—Propulsion			–.17			–.05			–.25			.11			.06
	Unit Test—Navigation and Electronics			–.18			–.28			–.13			–.40			–.15

N. B. The number of schools and pupils in columns 3, 4, 5, and 6 of this table represent the adjusted assignment to treatment groups for data analysis on the basis of the services actually rendered by project teachers.

TABLE 47

Comparison of Dropouts by Year

	Actual, 1960-61	Expected, 1960-61
Number of Dropouts	55	92
Number Completing the Courses	288	251
Totals	343	343

$\chi^2 = 20.3346^{**}$

Table 47 shows that a significantly smaller number of students dropped out of the program in 1960-61 than would have been expected on the basis of the dropout rate of the preceding year. This was probably due to the experience that schools and students obtained during the first year of the project — they knew more about what to expect.

TABLE 48

Comparison of Dropouts by Course, Using Dropouts from the First-Year Courses as the Norm

		Actual	Expected
Concepts of Mathematics II	Number of Dropouts	37	53.7
	Number Completing the Course	213	196.3
$\chi^2 = 6.6070^*$	Totals	250	250.0
Science for the Space Age II	Number of Dropouts	18	29.8
	Number Completing the Course	75	63.2
$\chi^2 = 6.8756^*$	Totals	93	93.0

In Table 48 the dropout rate in the second year in both courses is compared on the basis of the dropout rate of the preceding year. In both cases the holding power was greater than in the preceding year.

TABLE 49

Comparison of Dropouts by Year and by Course Each Year, Using Total Dropouts from Both Courses for That Year as the Norm

Course	Number Enrolled	Number Completed	Number of Dropouts	Dropout Percentage	Expected Dropouts
Concepts of Mathematics I	298	234	64	21.5	79.7
Science for the Space Age I	293	199	94	32.1	78.3
Totals for First Year	591	433	158	26.7	158.0
			$\chi^2 = 6.241^*$		
Concepts of Mathematics II	250	213	37	14.7	40.0
Science for the Space Age II	93	75	18	19.3	15.0
Totals for Second Year	343	288	55	16.0	55.0
			$\chi^2 = 0.825$		
Grand Totals	934	721	213	22.8	213.0
			$\chi^2 = 10.877^*$		

Table 49 shows that there was a significant difference in the first year but not in the second year in the holding power of the two courses. It shows again that the dropout rate during the first year was significantly greater than in the second year.

TABLE 50

Comparison of Dropouts by Treatments in the Mathematics Courses

	Concepts of Mathematics I		Concepts of Mathematics II	
Treatments	Actual Dropouts	Expected Dropouts	Actual Dropouts	Expected Dropouts
TV Only	28	29.8	10	12.1
Visits	20	19.4	15	15.5
Seminars	7	4.7	9	6.6
Seminars and Visits	9	10.1	3	2.8
Totals	64	64.0	37	37.0
	$\chi^2 = .2246$		$\chi^2 = 1.0851$	

TABLE 51

Comparison of Dropouts by Treatments in the Science Courses

Treatments	Science for Space Age I Actual Dropouts	Science for Space Age I Expected Dropouts	Science for Space Age II Actual Dropouts	Science for Space Age II Expected Dropouts
TV Only	29	27.4	5	2.6
Visits	40	40.5	6	8.4
Seminars	15	13.8	2	3.6
Seminars and Visits	10	12.3	5	3.4
Totals	94	94.0	18	18.0
	$\chi^2 = .4363$		χ^2 not computed	

In Tables 50 and 51 Chi-Square tests of the significance of the difference in the incidence of dropouts among the four treatments for each subject for both years are reported. None of the distributions is statistically significant at the five per cent level; consequently it may be asserted that there is no evidence in these data that supplementary services by assistant teachers affected the dropout rate.

TABLE 52

Comparison of Dropouts by Sex

Sex	Concepts of Mathematics I Actual Number	Concepts of Mathematics I Expected Number	Concepts of Mathematics II Actual Number	Concepts of Mathematics II Expected Number	Science for the Space Age I Actual Number	Science for the Space Age I Expected Number	Science for the Space Age II Actual Number	Science for the Space Age II Expected Number
Boys	44	44	16	24.5	56	64.7	10	14.2
Girls	20	20	21	12.5	38	29.3	8	3.8
Total	64	64	37	37.0	94	94.0	18	18.0
	$\chi^2 = 0$		$\chi^2 = 8.072^{*}$		$\chi^2 = 3.75$		$\chi^2 = 7.359^{*}$	

Table 52 shows that in 1960-1961 there were differences in the dropout rate according to sex that were significant at the five per cent level; there were no statistically significant differences during the first year. In both courses in the second year significantly fewer boys than girls dropped out.

It would appear that in one of the two years boys seemed more likely than girls to complete televised mathematics and science courses such as the Nine O'Clock Scholar Program.

TABLE 53

Comparison of Dropouts by Grade

Grade	Concepts of Mathematics I Actual Number	Concepts of Mathematics I Expected Number	Concepts of Mathematics II Actual Number	Concepts of Mathematics II Expected Number	Science for the Space Age I Actual Number	Science for the Space Age I Expected Number	Science for the Space Age II Actual Number	Science for the Space Age II Expected Number
10	10[1]	13.4	5	2.0	23	21.3	8	3.1
11	24	15.6	18	6.3	30	33.1	5	5.7
12	30	34.8	14	28.2	41[2]	39.7	5	9.2
Totals	64	64.0	37	37.0	94	94.1	18	18.0
	$\chi^2 = 6.1001^{*}$		$\chi^2 = 27.3975^{**}$		$\chi^2 = .4686$		$\chi^2 = 9.7485^{**}$	

[1] One grade 9 student added to the total for grade 10.

[2] Two post-graduate students added to the total for grade 12.

In 1959-60, the grade level of the student was a significant factor in the dropout rate in mathematics, but not in science. In 1960-61, it was a significant factor for both courses.

TABLE 54

Comparison of Dropouts of Grade 12 Pupils vs. Non-Seniors

Grade	Concepts of Mathematics I		Concepts of Mathematics II		Science for the Space Age I		Science for the Space Age II	
	Actual Number	Expected Number	Actual Number	Expected Number	Actual Number	Expected Number	Actual Number	Expected Number
Non-Senior	34	32	23	18.5	53	47	13	9
Senior	30	32	14	18.5	41	47	5	9
Totals	64	64	37	37.0	94	94	18	18
	$\chi^2 = .250$		$\chi^2 = 2.1892$		$\chi^2 = 1.5320$		$\chi^2 = 3.5554$	

When all of the non-senior pupils were combined and compared as a group with twelfth grade students in Table 8, it was found that there were no significant differences in the dropout rate.

It would appear that the grade level of the pupil was a minor factor in the dropout rate of the students who enrolled in these courses. There seems to be a trend toward better retention of grade 12 than grade 10 students, but the trend is not uniform.

TABLE 55

Comparison of Dropouts by Participation in Other Courses in Mathematics

Number of Mathematics Courses	Concepts of Mathematics I		Concepts of Mathematics II		Science for the Space Age I		Science for the Space Age II	
	Actual Number	Expected Number	Actual Number	Expected Number	Actual Number	Expected Number	Actual Number	Expected Number
0[1]/	16	5.6	5	1.0	23	12.5	4	1.3
2	30	34.0	15	8.7	46	60.1	11	7.8
3	31	37.4	23	33.3	44	40.4	4	9.7
Totals	77	77.0	43	43.0	113	113	19	19.0
	$\chi^2 = 20.879^{**}$		$\chi^2 = 14.1230^{**}$		$\chi^2 = 15.34^{**}$		$\chi^2 = 7.1748^{*}$	

Table 55 shows that the number of additional courses in mathematics that had been or were being taken was a significant factor both years in the dropout rate in the televised science courses as well as the mathematics courses. In all four cases more students with no additional high school courses in mathematics dropped out of both of the televised courses than would have been expected. In three of the four televised courses, fewer pupils with three or more courses than were expected to drop out did so. The dropout rate for pupils who had two additional mathematics courses was contradictory, with fewer than the expected number of dropouts the first year and a larger number the second year.

TABLE 56

Comparison of Dropouts by Participation in Other Courses in Science

Number of Science Courses	Concepts of Mathematics I		Concepts of Mathematics II		Science for the Space Age I		Science for the Space Age II	
	Actual Number	Expected Number	Actual Number	Expected Number	Actual Number	Expected Number	Actual Number	Expected Number
0[1]/	16	10.0	7	3.0	25	14.8	5	1.3
2	31	32.0	19	19.6	46	57.8	10	10.7
3	31	36.0	17[2]/	20.4	42	40.4	4	7.0
Totals	78	78.0	43	43.0	113	113.0	19	19.0
	$\chi^2 = 4.607$		$\chi^2 = 1.0782$		$\chi^2 = 9.502^{**}$		$\chi^2 = 1.9357$	

[1]/ 0 = No previous courses in this subject area since first enrolling in grade 9, and also no concurrent courses in this area.
2 = Two courses in this subject area, including courses taken this year.
3 = Three courses in this subject area, including courses taken this year.

[2]/ Includes 4 pupils who had been enrolled in Concepts of Mathematics I.

Table 56 indicates that the number of additional science courses that had been or were being taken was a significant factor in the dropout rate of the first-year of the program for both mathematics and science, but was not significant the second year for either course.

In the first year, more students than were expected with no previous or concurrent courses in science dropped out. Fewer than the expected number of pupils with two additional courses dropped out. Fewer students with three additional courses in science discontinued in the mathematics course, but more than the expected number of televised science course students with three additional science courses dropped the program.

From the data in Tables 55 and 56, it was concluded that the amount of preparation in related areas has some effect on the dropout rate, but there is not a regular decrease in the proportion of drop-outs as the amount of preparation increases. Also, preparation in regular mathematics courses seems to be more helpful than science courses in lowering the dropout rate of students in televised science and mathematics courses such as those presented in this project.

TABLE 57

Comparison of Mean Scores on Unit Achievement Tests and End-of-Course Tests of Pupils Who Completed the Courses with Scores of Dropouts

		MEAN ACHIEVEMENT TEST SCORES					
	Pupil Status	Test #1	Test #2	Test #3	Test #4	Test #5	Test #6
Concepts of Mathematics I	Completes	79.0	71.0	68.0	75.0	—	—
		(38)	(10)	(10)	(9)		
	Dropouts	76.9	74.6	63.4	70.2	—	—
Concepts of Mathematics II	Completes	77.1	79.1	77.0	80.1	78.1	86.9
		(38)	(15)	(12)	(6)	(4)	(3)
	Dropouts	68.3	72.9	68.9	76.0	71.0	44.0
Science for the Space Age I	Completes	28.1	31.6	28.3	31.4	17.5	—
		(34)	(5)	(4)	(3)	(1)	
	Dropouts	23.0	23.4	18.8	22.0	16.0	—
Science for the Space Age II	Completes	20.1	22.4	—	—	—	—
		(17)	(5)				
	Dropouts	18.4	17.0	—	—	—	—

Note: The number of dropouts who took each test is indicated in parentheses. Although 7 unit tests plus a final test were given, test scores for the "completes" are recorded only when there are scores for dropouts.

There were 17 comparisons and in only one of these did the dropouts secure higher scores than did the completes. This appears to be significant, but it was not tested because of the fact that the 17 comparisons are not all independent.

TABLE 58

Comparison of Mean Scores on Fall Administration of SCAT and Related STEP and FAS Tests of Pupils Who Completed the Courses with Scores of Dropouts

Course	Test	Pupil Status	Number of Pupils	Mean Scores	Standard Deviation	t-Ratio
Concepts of Mathematics I	SCAT (Verbal)	Completes	234	299.87	13.3881	
		Dropouts	64	295.90	13.2524	1.5567
	SCAT (Quantitative)	Completes	213	316.38	10.7674	
		Dropouts	64	310.40	11.7446	2.7306*
	STEP (Mathematics)	Completes	224	295.13	22.5967	
		Dropouts	64	282.00	37.3593	2.1109*
Concepts of Mathematics II	SCAT (Verbal)	Completes	213	300.09	12.4725	
		Dropouts	37	296.00	10.8254	1.5551
	SCAT (Quantitative)	Completes	213	317.60	11.7128	
		Dropouts	37	311.57	12.1177	2.1613*
	STEP (Mathematics)	Completes	213	294.55	10.7166	
		Dropouts	37	287.92	6.6337	4.8790*

Course	Test	Pupil Status	Number of Pupils	Mean Scores	Standard Deviation	t-Ratio
Science for the Space Age I	SCAT (Verbal)	Completes	187	299.63	12.1699	
		Dropouts	94	298.38	14.1429	.5297
	SCAT (Quantitative)	Completes	187	312.89	12.0042	
		Dropouts	94	312.13	12.7680	.3455
	STEP (Science)	Completes	195	296.10	11.7371	
		Dropouts	82	285.65	45.6666	1.7755
	FAS-1	Completes	199	27.31	3.6063	
		Dropouts	84	26.01	4.6764	1.6960
	FAS-2	Completes	199	27.43	5.0128	
		Dropouts	84	25.76	5.2395	1.7997
Science for the Space Age II	SCAT (Verbal)	Completes	75	299.12	14.4582	
		Dropouts	18	298.33	11.7898	.1740
	SCAT (Quantitative)	Completes	75	311.85	13.8349	
		Dropouts	18	314.33	11.9536	- .5499
	STEP (Science)	Completes	71	297.21	17.0451	
		Dropouts	17	290.82	16.0110	1.0579
	FAS-1	Completes	71	26.99	4.0368	
		Dropouts	17	25.82	4.9468	.6834
	FAS-2	Completes	71	27.48	4.7531	
		Dropouts	17	26.53	4.0729	.5989

Table 58 shows that in Concepts of Mathematics in both years there were no significant differences between the mean scores earned by the completes as compared to the dropouts on the SCAT (Verbal). In both years, however, there were significant differences between the mean scores earned by these two groups on both the SCAT (Quantitative) and the STEP Mathematics. It seems reasonable to assume from this evidence that lack of mathematical or quantitative ability was a reason for withdrawal from the televised courses in mathematics.

The same table indicates that none of the five standardized tests could be used to predict dropouts.

TABLE 59

Reasons Given by Students for Dropping Televised Course

Reason for Dropping Course	Number of Responses	Percent of Total Responses
Conflicts	37	41.57
Inadequate Background	25	28.09
Negative Pupil Attitudes	13	14.61
Physical Limitations	6	6.74
Poor School Discipline	3	3.37
Other Reasons	5	5.62
Totals	89	100.00

KEY

Conflicts — insufficient time for required study because of demands of regular school subjects, better liked school subjects, or extra-curricular activities.

Inadequate Background — subject matter too difficult because of inadequate knowledge of subject area.

Negative Pupil Attitudes — courses uninteresting, or little value, teacher inadequate or uninteresting.

Physical Limitations — death, extended illness, or withdrawal from school.

Poor School Discipline — confusion in television classroom because of inadequate supervision.

Other Reasons — negative attitude of school personnel, lack of direct assistance, pace of teaching too rapid, late arrival of textbooks.

To obtain the data reported in Table 59, an open-end questionnaire was mailed, with stamped return, in April 1961, to the home addresses of all of the pupils who had dropped either of the courses in either year. The questionnaire listed reasons commonly given by students for failing to continue in televised courses in previously reported studies. Eighty-nine usable responses were received.

Many of the students listed two, three, or more reasons for discontinuing the courses. In each of these instances staff members studied the response and assigned it to one of the six categories listed in Table 59 that seemed to represent the most important reason for dropping the course.

Multiple listing of reasons for withdrawal does not necessitate that the categories are highly related. A student with a single reason for withdrawal might have that as a very strong reason. On the other hand a pupil with additional reasons for withdrawal might find that a minor conflict with other courses would cause him to withdraw.

Conflicts with other courses was the reason most frequently given by students, and inadequate background was the second. Together, these two reasons were the ones for which 70 per cent of the pupils said they withdrew.

Summary and Conclusions

Examination of the data reported in studying this hypothesis led to the following conclusions:

1. The dropout rate during the second year was lower than during the first year in both courses.
2. The holding power of the mathematics course was superior to that of the science course during the first, but not the second year.
3. There was no evidence that the amount or kind of supplementary service provided by the assistant teachers materially affected the dropout rate. Generally, the students who had none of these services tended to remain in the course about as frequently as did the three other groups.
4. In 1959-1960 there were no statistically significant differences in dropouts by sex. In 1960-1961 significantly fewer boys than girls dropped out.
5. The grade level of the pupil appeared to be a minor factor in the dropout rate. There seemed to be a trend toward better retention of grade 12 than grade 10 students, but the trend was not uniform.
6. The number of concurrent or previously taken courses in related areas had some effect on the dropout rate, but the proportion of dropouts did not decrease consistently as the amount of preparation increased. Additional courses in mathematics seemed to be more helpful than science courses in decreasing the dropout rate in the televised courses in both mathematics and science.
7. Lack of mathematical ability and general knowledge of mathematics as revealed on standardized tests administered at the beginning of the year seemed to be a significant reason for withdrawal from the televised mathematics courses. None of the standardized tests showed predictive value for dropouts from the televised science courses.
8. It would appear that the sixth hypothesis is, in part, valid. All of the factors except " variations in the amount of supplementary assistance " have some validity. These factors are more applicable to courses such as the two in Concepts of Mathematics than to the two in Science for the Space Age.

CHAPTER V. REACTION OF PRINCIPALS AND STUDENTS OF PARTICIPATING SCHOOLS, COLLEGE ADMISSIONS OFFICERS, COLLEGE TEACHERS, AND ADULT VIEWERS

Participation

In the first section of this chapter participation in the project is analyzed by numbers of schools and by numbers of pupils. The purpose of these analyses is to show the extent to which approval of the first-year program was reflected by continuation of participation for a second year by schools and students.

In Chapter III it was reported that in 1959-1960 sixty-five of the 181 schools within the viewing area participated in the project. One hundred and sixteen schools which could have used the program did not do so.

Among the reasons given for failure to participate this year were the following:

1. The availability of the program was announced too late to permit adjustment of schedules and recruitment of pupils.
2. Existing school schedules were arranged to serve most efficiently the needs of most pupils. It would not be practical to rearrange these schedules to accommodate a few pupils at the expense of the large majority. Also, the project was frankly experimental and there was uncertainty as to whether the value to be received by participating students would be adequate compensation for the inconvenience of schedule adjustment.
3. Some schools already were presenting in conventional courses the material that would be taught by television.
4. It was not possible to free a teacher at the time of the telecasts to supervise the pupils. Also, the teachers were so heavily burdened that it would not be proper to ask any to assume an additional responsibility.
5. It was impossible to obtain the funds for the purchase of a television receiver and for the erection of an antenna. Also, the principal would not object to participation if he could be guaranteed that his students would not be expected to attend a seminar. Neither money nor staff were available locally to provide this service merely for experimental purposes.

Despite all of these difficulties, more than one-third of the schools which could receive an adequate television signal did participate in the first-year program. The means used to recruit these 65 schools are discussed in Chapter VI.

Thirty-six (55 per cent) of the 65 schools that participated in 1959-1960 continued to participate in 1960-1961.

Principals of 23 of the 29 schools which did not continue to enroll pupils during the second year replied to the 1961 questionnaire concerning their attitude toward the program. All but four listed strengths of the televised courses, and three of these four left the " weaknesses " space blank. One principal merely stated that his school did not participate in the second year.

It is assumed that among the greatest weaknesses of the program listed by these principals would be found their reasons for failing to continue the second year. Seven principals listed scheduling difficulties; six, lack of face-to-face contact between television teacher and pupil; five, course content too difficult or inappropriate; three, heavy load of regular college preparatory subjects; three, teaching weaknesses; two, inability of the coordinator to find time to supervise pupils; and one each " lack of space;" " lack of competition with only one pupil enrolled;" and " no weaknesses."

Recruitment efforts for the second year were far less intensive than for the first year. Nevertheless sixteen new schools were added in 1960-1961, which seems to indicate that the first-year courses were creating a favorable impression in the state.

Of the 54 schools enrolled in Concepts of Mathematics I, 31 (57.4 per cent) continued with this course for a second year. Nineteen additional schools enrolled pupils in Concepts of Mathematics II.

Of the 45 schools participating in Science for the Space Age I, 20 (44.5 per cent) continued for the second year. Six new schools participated in 1960-1961.

TABLE 60

Number and Percentage of Schools Enrolled in One or Both Subjects for One or Both Years

		Extent of Enrollment by Schools						Total Enrollment in Each Course			
	Total Number of Different Schools Enrolled	Mathematics Only		Science Only		Both Mathematics and Science		Mathematics		Science	
Year		Number of Schools	% of Total	Number of Schools	% of Total	Number of Schools	% of Total	Number of Schools	% of Total	Number of Schools	% of Total
1959-60	65	20	30.7	11	17.0	34	52.3	54	83.0	45	69.7
1960-61	52	26	50.0	2	3.7	24	46.3	50	96.3	26	50.0
Both Years	25	8	22.2	—	—	17	47.3	31	86.0	20	55.5

FIGURE 13

Percentage of Schools by Course Enrollment, 1959-1960

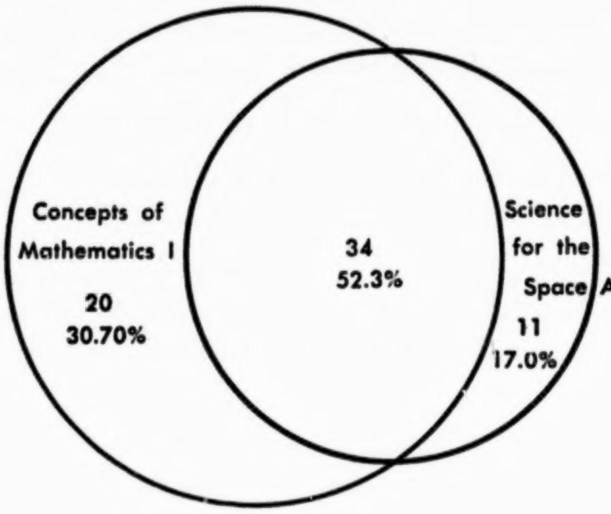
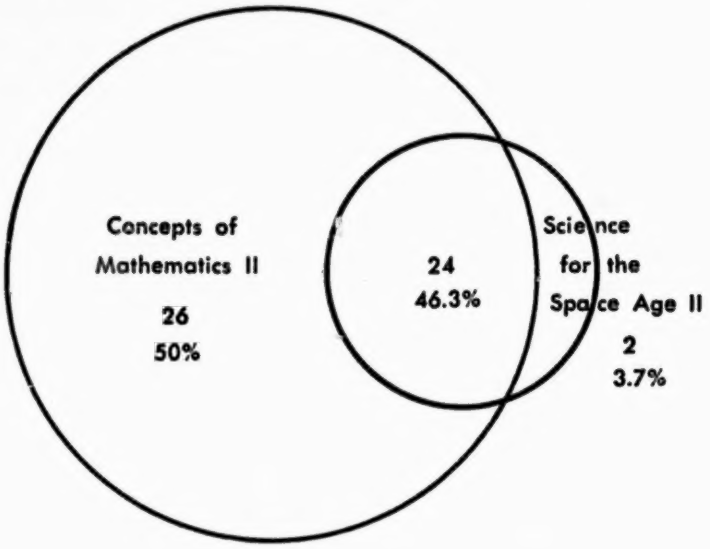


FIGURE 14

Percentage of Schools by Course Enrollment, 1960-1961



In 1959-1960, more schools enrolled pupils in the mathematics course than in science (Table 60 and Figure 13). However, the difference in the number of schools participating in each program was not statistically significant ($\chi^2=.90$).

In the second year, the number of schools participating in the mathematics course was almost twice the number enrolled in the science program. The variation was significant ($\chi^2=7.5788^*$). The preference for mathematics in the second year may be attributed to a number of considerations.

Principals and students may have felt that the science course overlapped the content of existing science courses more than the mathematics course did. Also, the lack of laboratory experiences in Science for the Space Age, which many people feel are an important part of science courses, became more noticeable.

Publicity had been given to the fact that a unit of trigonometry, which had been prepared with the assistance of the University of Maine Director of Admissions, would be a part of the second-year mathematics course. The University had indicated that successful completion of this course would be accepted in lieu of a conventional course in trigonometry to meet one of the requirements for admission to the College of Technology. This announcement probably was the most important factor in causing small schools to use the televised mathematics course.

TABLE 61

Number and Percentage of Students Enrolled in Each Course and in Both Courses in Each Grade, 1959-1960

Course	Number and Percentage of Students Enrolled, 1959-1960								
	Grade 10		Grade 11		Grade 12		Totals		χ^2
	Number	%	Number	%	Number	%	Number	%	
Concepts of Mathematics I	59	19.0	87	28.1	164[2]/	52.9	310	100.0	57.238**
Science for the Space Age I	70[1]/	22.6	111	35.9	128[2]/	41.4	309	99.9	17.262**
Both Courses	17	17.0	35	35.0	48	48.0	100	100.0	14.555**

[1]/ Includes one 9th grade pupil.

[2]/ Includes one post-graduate pupil.

TABLE 62

Number and Percentage of Students Enrolled in Each Course and in Both Courses in Each Grade, 1960-1961

Course	Number and Percentage of Students Enrolled, 1960-1961								
	Grade 10		Grade 11		Grade 12[2]/		Totals		χ^2
	Number	%	Number	%	Number	%	Number	%	
Concepts of Mathematics II	19[1]/	7.4	59	23.0	178[3]/	69.5	256	99.9	160.321**
Science for the Space Age II	21	22.3	26	27.7	47[2]/	50.0[1]/	94	100.0	12.161**
Both Courses	2	9.5	8	38.1	11	52.4	21	100.0	6.000*

[1]/ Includes one 9th grade pupil.

[2]/ Includes one post-graduate pupil.

[3]/ Includes 4 post-graduate pupils.

Tables 61 and 62 include all of the pupils who were listed for enrollment by their schools. The totals differ, therefore, from those in Table 2, Chapter III, from which the pupils with incomplete data were excluded.

Tables 61 and 62 show that the distribution of pupils among the three grades varied significantly each year and in each course, and also among the pupils who enrolled each year in both courses.

TABLE 63

Comparative Distribution of Enrollment by Grade

Grade	Concepts of Mathematics II Number of Students Enrolled			Science for the Space Age II Number of Students Enrolled		
	Actual	Expected	χ^2	Actual	Expected	χ^2
10	19	48.6	18.028**	21	21.3	.042
11	59	72.0	2.347	26	33.8	1.800
12	178	135.4	13.403**	47	38.9	1.687
Totals	256	256.0	33.878**	94	94.0	3.529

Table 62 shows the distribution of enrollment by grade in 1960-1961 in comparison with what would have been expected on the basis of the distribution in 1959-1960.

In the mathematics course the decrease in the relative numbers of grade 10 pupils and the increase in the relative numbers of grade 12 pupils was significant. This may in part have been caused by the plan to introduce an extended unit on trigonometry. There are no significant differences in the science course.

Slightly more than one-half of the students in the first-year mathematics course were in grade 12; in the second year the percentage of grade 12 students increased to more than two-thirds. The enrollment increase in the science course was not a significant one.

TABLE 64

Completion Record by Grade of Pupils Who Enrolled in Televised Courses in Both Years

Grade In 1959-1960	Numbers of Pupils Completed Both Years	Dropped First; Completed Second	Completed First; Dropped Second	Dropped Both Years	Totals
10	13¹/	2	5	—	20
11	30	7	3	2	42
Totals	43	9	8	2	62

¹/ Includes one grade 9 pupil.

In 1959-1960 there were 1 student in grade 9, 80 in grade 10, and 110 in grade 11. The one freshman pupil continued with the program the following year, as did 12 of the sophomores (15 per cent) and 30 of the juniors (27.5 per cent).

Of the 191 non-senior students who participated in the first-year courses, a total of 43 (22.5 per cent) continued for the second year. This seems to be a respectable percentage, because for some of the others, their schools ceased to participate. Also, many may have felt the course content would not be sufficiently different in the second year although it was advertised as different.

Table 63 shows that the number of eleventh grade pupils in 1959-1960 who continued in the program to completion the following year was significantly larger than the number of students below the eleventh grade.

Comments by participating students concerning the value and quality of Concepts of Mathematics are reported in the discussion of the first hypothesis in Chapter IV.

Attitudes of Principals of Participating Schools

Early in the summer of 1961 a questionnaire was sent to the principal of each of the 81 schools which had participated in the Nine O'Clock Scholar Program in 1959-1960 or 1960-1961. Three questions were asked:

1. Were the TV courses worth the time and effort required to permit your students to participate?
2. What were the program's greatest strengths?
3. What were the program's greatest weaknesses?

Principals were encouraged to list three responses to the second and third questions.

Seventy-five of the 81 principals completed the forms and returned them to the project staff. Of these 75, 65 answered " yes " to the first question or gave a clearly positive answer. Three replies left the question blank. Seven stated a definite unwillingness to take part if the program were to be offered again.

Many principals with clearly favorable replies did not merely answer " yes," but commented or expanded on the answer, " yes." Examples are:

" We would like to have had wider participation."

" Yes, very definitely. The one exception might be the one or two pupils who should have been screened out in the first place."

" We felt that they were very much worth the time and effort, and the students involved voiced the same reaction."

" In some ways, yes. I believe the individuals gained from the courses. Our conditions were not ideal, however."

" Definitely."

" Pre-eminently so."

" For the most part, yes."

" They were worth their weight in gold. Very valuable to our pupils."

" Scheduling the program is very difficult, and we believe that only excellent students who can make up work missed in their other classes should participate in the future."

" Mathematics, yes."

" I believe they were of value for our students."

" Yes, congratulations."

" Very much so."

" Absolutely."

Three principals replied " no " to this question. One stated " My teachers failed to think so." Three others left this question blank, but the answers to the second and third questions were so worded as to indicate clearly that the principal would choose to participate again if he were given an opportunity to do so.

The responses to both the second and third questions were grouped under three major classifications. Each of these in turn was categorized to permit ready interpretation of these data.

TABLE 65

Greatest Strengths of the Program

	Number of Responses
1. Showed values of educational television for superior students in small schools	
a. Provided broader and deeper course content than is otherwise possible in small schools	57
b. Provided genuine challenge and competition for superior students	18
c. Gave students more responsibility than in regular courses	6
d. Motivated good work; held pupils' attention	4
e. Provided experience with college-type teaching	3
f. Gave pupils status in school, and school in community	2
g. Provided all pupils same viewing vantage point	1
Total number of responses	91
2. Approval of course content and presentation	
a. High quality of teaching and lesson planning	33
b. Valuable course content	10
c. Increased pupil interest in subject matter	10
d. Approved teaching techniques	8
e. Satisfactory difficulty level	1
Total number of responses	62
3. Approval of factors due to experimental situation	
a. Valuable assistance given to pupils by project assistant teachers	6
b. Valuable service of local coordinator in supervising work of students	1
c. Improvement of program with experience	1
Total number of responses	8

TABLE 66

Greatest Weaknesses of the Program

	Number of Responses
1. Showed problems inherent in educational television in general	
a. Lack of face-to-face contact between television teacher and pupil; need for some or more school visits	29
b. Adjusting local class schedules in period length, time of day, vacations, including scheduling project staff visits	26
c. Poor or interrupted reception	5
d. Excessive paper work, delay in receipt of test results, little or no checking of homework	3
e. Inflexibility of commercial station schedules	2
Total number of responses	65
2. Disapproval of course content and presentation	
a. Poor teaching; occasional errors, too few tests; too few practical applications, faulty techniques	10
b. Unsatisfactory teaching level — too easy, too difficult, inconsistent	7
c. Inattention of pupils; lack of motivation	6
Total number of responses	23
3. Disapproval of factors due to experimental situation	
a. Role of local coordinator—need for a more active role; need for free time to supervise participating students; resultant lack of discipline	12
b. Deliberate choice of course content that was " additional " although " useful "	9
c. Excessive additional testing required for experimental purposes	8
d. Eleventh-, and especially tenth-grade pupils not sufficiently well prepared to enroll in same courses with those in grade 12	5
e. Faulty camera work	1
Total number of responses	35

There were 91 comments favorable to television in the school and 65 were unfavorable. Of the 91 favorable comments, 57 were fairly specific to the point that television did allow a broadening and deepening of course content in small schools.

Of the 65 unfavorable comments, 55 of them concerned lack of face-to-face contact between teacher and pupil and scheduling problems, both of which are inherent in educational television and do not outweigh its advantages completely.

There were 62 comments favorable to the course content and presentation and only 23 unfavorable comments. Some of these comments, of course, were specific to only one of the four courses which were presented. This seems to represent overall approval of the choice of content and manner of presentation of the courses given by the project, as do most of the comments classified in the sub-categories of the value of televised instruction.

The third category contains comments specific to this project as an experiment. While only 6 favorable comments were made concerning the efforts of the visiting teachers, this may not indicate a lack of appreciation for that aspect of the project, but probably was due to the fact that the questionnaire was free-response and the principals' attention was not called to this feature of the project.

The negative comments specific to the experimental situation might have been more frequent also if the work of the visiting teachers had been specifically listed on the questionnaire.

The role of the coordinator had been minimized deliberately in order to determine the effect of television teaching and visiting teachers. The negative comments about course content might be expected whatever course was given, but the experimental situation was such that the content was not planned with the schools in advance to fit into existing curricula. Instead, the content was selected intentionally so that it would not too greatly overlap conventional high school or college courses.

The principals seem to have shown great understanding and forbearance since only eight of them complained about the amount of time required for the many tests and questionnaires of the project.

Additional evidence of the attitude of project staff members, college professors, and participating students is reported in Chapter IV in the discussion of the first and fourth hypotheses.

Attitudes of College Admissions Officers

One of the questions frequently asked by school principals was how participation in the Nine O'Clock Scholar Program would affect a student's admission to college.

Early in the first year Maine college admissions officers were open-minded and sympathetic, but, quite properly, were reserving judgment until they could learn more about the televised courses. This attitude is illustrated by the following excerpts from a letter from Hubert S. Shaw, Director of Admissions, Bowdoin College, Brunswick, Maine, dated September 17, 1959.

" . . . . I can see no particular problem involved with granting credit to such courses provided that a sufficient description of the course and of a student's achievement in a course is available for examination by admissions officers . . . "

" I have had one or two inquiries from parents of students who have been invited to participate in this program, and I have urged them to do so because as an experiment, it must obviously reach students who could make the experience work successfully or at least prove the effectiveness of such a program. I am sure that most directors of admission will view the records of students who present work in this program with reasonable open-mindedness and will examine the records with an eye to flexibility in interpreting the results. We certainly want to cooperate in every way possible, and I hope that you will call upon us for additional help if we can provide it."

In February, 1960, the directors of admissions of Maine's four largest colleges — the University of Maine, Bates College, Bowdoin College, and Colby College — met to formulate a joint policy concerning admissions credit for the televised courses. The following statement was mimeographed and distributed to all Maine secondary schools in March 1960.

"Admissions Policy for Proposed Television Courses

" The colleges' policy in regard to admission credit for television courses recognizes several objectives:

1) The elimination of student anxiety regarding use of such courses for college admission credit.
2) The preservation of a strong college preparatory program.

3) The provision for a 'bonus' course in large schools where the variety of courses offered is broad; i.e. four years of mathematics, more than one language and more than two years in each, courses in United States, World, Ancient, European History, and two laboratory sciences.

4) The opportunity for small schools to add to the variety of courses offered; i.e. if only three years of mathematics are offered, then such a television course could provide a stimulating course in the senior year.

5) The adherence to a minimum of sixteen Carnegie units as a guide to planning but discretion in interpretation; i.e. it is obvious that four English, four mathematics, three language, two history and two science units usually furnish a strong foundation for continuation of such courses in college, yet only fifteen units show. Is it reasonable to say that the student is not qualified for college by taking a television course in his senior year to make the sixteenth unit instead of Problems of Democracy or a third laboratory science or a fourth year language?

"The television courses are desirable when, for a particular school, they bolster the quality of the college preparatory program, or serve to expand the offerings of the normal college preparatory program, or introduce students to the lecture and note-taking characteristics of college study.

"If, in the judgment of school officials, (1) the offered mathematics course does not interrupt the usual course sequency leading up to college level courses, (2) the science course does not supplant an available laboratory science course of similar quality or (3) neither course displaces a more appropriate college preparatory subject locally offered, the course will be accepted for admission credit with the normal requirements that: (1) the grade received be at, or above, the usual college certificate grade for the school, (2) the remainder of the college preparatory course meet entrance requirements, (3) work in the course merits the recommendation of the appropriate school official.

"Summary Statement

"Provided the offered television courses occupy a justifiable place in a local curriculum, colleges will interpret the sixteen Carnegie unit program with sufficient leeway to allow credit for the proposed television courses."

Effective in the fall of 1960, a half-year course in trigonometry was a requirement for admission to the College of Technology of the University of Maine. Many of the smaller secondary schools in the state did not have teachers qualified to offer this course. In other cases too few pupils would be enrolled to make the course economically practicable.

During the summer of 1960 the Concepts of Mathematics staff planned an extended unit in trigonometry with the close cooperation of Mr. James Harmon, the University of Maine Director of Admissions. As a result it was possible to announce that the University of Maine would accept successful completion of the televised mathematics course in lieu of a half-year of trigonometry for applicants for admission from the smaller secondary schools.

Attitudes of College Teachers

The comments of college teachers toward the televised courses are reported in the discussion of the first hypothesis of Chapter IV.

Attitudes of Adult Viewers

Before the first courses were televised in the fall of 1959, executives of the commercial television stations expressed concern lest they lose their adult viewing audience while the Nine O'Clock Scholar program was being presented. Partly to help hold the home audience, and partly to provide an additional service, the courses were opened to adult participation.

Interested adults were invited to write to their television station or directly to the project staff to register as students. Copies of the study guides prepared for in-school pupils were sent to these registered persons at the same time they were sent to the schools. Unit tests and answer keys were mailed one week after they were distributed to the schools.

Adult viewers could either audit the courses or take them for high school equivalency certificate credit. Those who wished to be given credit were asked to go to a nearby school at the conclusion of the courses to take the end-of-course achievement tests under the supervision of a teacher.

Wide publicity was given to the availability of these courses to adults through the television stations, the daily newspapers, periodicals of the Maine Congress of Parents and Teachers and the Maine Municipal Association, and letters sent by the staff to the officers in civic, fraternal and service organizations throughout the state. In addition, the title of the basic texts was shown each day on television during the first two weeks of the courses.

TABLE 67

End-of-Year Adult Enrollment in the Nine O'Clock Scholar Courses

Course	1959-60	1960-1961
Concepts of Mathematics	268	128
Science for the Space Age	155	71
Totals	423	199
Number of Different Individuals	301	139

Table 67 reports the number of adult viewers who enrolled in the courses and who at the end of the year indicated that they had been participating with more or less regularity and wanted to continue to receive course materials. The drop in adult participation during the second year may be due in part to the greatly decreased effort to enlist adult enrollment and in part to the similarity in course content which may have been expected when the course titles were not changed.

In June of 1960 ten adults took the end-of-course achievement tests at schools near their homes and were awarded certificates signed by the Commissioner of Education. Two of these persons earned certificates in both courses; eight qualified in Concepts of Mathematics only.

In June of 1961 six adults took the final examinations and were granted certificates in Concepts of Mathematics.

Each year the television stations made their usual surveys to estimate the audience-holding power of their programs. In all instances the station management indicated that while the Nine O'Clock Scholar audience was slightly smaller than that usually expected at the time of day when the courses were presented, it was satisfactory for an educational program.

The following letter to the Project Director from Mr. George Gonyar, Program Director of WABI-TV in Bangor typifies the attitude of the television station executive. The letter was dated August 25, 1961.

> " As we look into the new fall program season, we note that the '9 O'Clock Scholar' program will not be with us again this year. May we take this opportunity to express our complete satisfaction with the way your office handled this series during the past years. We were delighted to have the opportunity to provide a service for the State Department of Education and for the youngsters in our schools who were the benefactors of the program.
>
> " May we add that at any time in the future '9 O'Clock Scholar' is offered again, WABI-TV and the Hildreth Television Network would indeed be interested in presenting the program. This is in line with our philosophy that our stations constantly serve the needs of the people in our state and communities in the best way possible."

Additional evidence of adult participation is presented by the following excerpts from a feature story in the January 31, 1960, issue of the Portland Sunday Telegram:

" A NEW KIND OF MORNING PICKUP "

" Housewives and Others Discovering Lure of Educational Television "

" Maine's 'Nine O'Clock Scholar' project — two televised courses presented daily by the State Department of Education — may have been devised for high school students, but it's attracting plenty of attention from folks long out of school.

> " 'Concepts of Mathematics' and 'Science for the Space Age' are presented between 9 and 10 o'clock every school day over hookups of Maine commercial television channels that cover the greater part of the state.
>
> " Produced with funds available through the National Defense Education Act, the courses were planned by Dr. Joseph J. Devitt of the State Department of Education to provide challenging educational opportunities to boys and girls of superior mental ability in the high schools of the state.
>
> " While the courses are serving the purpose for which they are devised, they are also appealing to a large audience of out-of-schoolers.
>
> " From York County to the northernmost sections of Aroostook, men and women, especially housewives, are writing to the television stations and the State Department requesting materials and information to use in connection with their viewing.
>
> " 'It's great,' says one woman who, admitting to 65 years of age, declares, 'I find the material is presented in a most challenging manner.'

" Mothers watch to see what the children are studying and then find to their surprise that they are learning many things they need to know if they are going to take an intelligent part in family dinner-table conversation of space-agers.

" Morning coffee breaks in suburban neighborhoods, formerly devoted to discussions of baby's formula, the latest fashions, and the ' have you heards ' so common to casual gatherings, have taken on a more serious note as two or three young mothers meet after children are off to school to learn together through this new medium.

" Interest in the courses isn't limited to women, but, of course, more of them can arrange their schedules to watch morning programs.

" Even with three small children at home, one ambitious young housewife finds time for this hour of ' something of lasting value.'

" A private tutor thinks watching these courses will help her to be better informed when working with individual children.

" A young man, unable to attend high school regularly because of poor health, feels he is making up for some of the things he would otherwise lose by watching daily lessons and preparing the assignments.

" ' We are never too old to learn and that's what I aim to do,' writes one participant in congratulating the originators of the plan for ' farseeing promotion.'

" And a man over 40, who never finished high school, hopes to gain credit toward a high-school equivalency certificate.

" Out of school 20 years, one woman found watching the science course reactivated an early interest in minerals, while another, a former mathematics teacher, says she's planning the schedule for her three small children so she has time to refresh the knowledge she hasn't used too much in the past 10 years.

" ' And there's always something new to learn, too,' she says.

" Some self-employed and retired men also have signified their interest and have participated.

" Adult viewers who seek credit toward ultimate high school graduation or high school equivalency certificates do textbook assignments and take final examinations in addition to watching the daily televised classes."

The following letter to the Editor of the Bangor Daily News was printed in the fall of 1961:

" Editor, Bangor Daily News:

" Regarding ETV as a means of improving teachers (and hence, students).

" There are many reasons why teachers, active and potential, need to amplify their knowledge. Science, mathematics and history particularly are undergoing rapid changes. Few subjects are static. To go back to college full time, or even to summer school, is essentially impossible for many. Furthermore, the summer schools do not necessarily offer the most needed courses.

" I believe that ETV courses, preferably offered for credit, afford the best method for reaching the largest possible number. My belief in the effectiveness of this method is largely based upon my experience as an observer in the two courses offered last year to high school students over channels 6 and 13 (and others). I listened to and watched practically all the lectures, studied the supplementary matter sent out from Augusta, and, in fact, acted the part of a student, although in my own living room.

" It may be noted that the course content of these courses was highly varied, and, hence, rather more difficult than the average course. The material offered was largely new to me, although in line with my experience and training.

" My conclusions are that ETV is an effective means of education; that ETV is the only means of reaching a very large number of teachers; that ETV offers a unique opportunity to those Junior and high school teachers who admittedly are assigned to teach subjects for which they have inadequate training.

Emerson P. Lambe,
Prof. Emeritus In Physics
Pratt Institute "

From the data reported in this chapter and in chapter III, it seems reasonable to form the following conclusions:

1. Schools and their pupils generally appreciated sufficiently the benefits of the first-year courses to re-enroll the second year.
2. The students appreciated the value of the courses more after they had begun their college programs than they did while they were enrolled in the courses.
3. Principals of participating schools generally approved of the Nine O'Clock Scholar and indicated that they believed the courses were well worth the time and effort required to permit their students to take part.
4. The college admissions officers approved the courses as part of the preparation of college bound youth, particularly for students from small high schools.
5. Adult viewers demonstrated their approval of the program by the highly satisfactory extent of their formal enrollment and by their unsolicited comments.

CHAPTER VI. PROBLEMS OF TV TEACHING

Problems Encountered in this Study

Enlistment of participation. In 1959, prospects for an educational television facility in Maine seemed dim. A music course for elementary school children twice a week for one year on commercial television, the Continental Classroom, and a few scattered college-level courses presented by Maine colleges, were all the educational television that had been offered in Maine until this time. In the Nine O'Clock Scholar Program, Maine secondary schools were asked for the first time to enroll pupils in televised courses during the school day.

The research proposal was submitted on November 14, 1958. Because of the many organizational problems involved in establishing the machinery to administer the new National Defense Education Act, it was not possible until the following March for the U. S. Office of Education to notify the Department of Education that the proposal would be approved.

Maine schools close early in June. By March many of them have already developed their schedule for the following school year. For obvious reasons, none of the television teachers had been employed in March.

In effect, Maine secondary-school principals were asked to register some of their ablest students, for courses which had yet to be built by teachers who had not even been employed at the time and which were to be taught through a medium with which the principals were not familiar. Principals were asked, in effect, to accept the assurance of the State Department of Education that the expenditures of their own and their students' time and effort would be repaid by the value of the educational experience provided to the students.

It was necessary to obtain participation by large enough numbers of schools and pupils to permit statistically valid comparison of the achievement of the four treatment groups. Several means were used to enlist the cooperation of Maine schools.

Immediately upon receipt of notification in March that the proposal had been approved subject to some minor revision, a three-page letter was sent to each superintendent of schools and to each secondary-school principal. In this letter the nature of the program was explained and schools were invited to take part. During the late spring and the summer, additional letters were sent to superintendents and principals, announcing the names of project personnel as they were appointed, and supplying additional information as it became available.

Late in the spring of 1959 a series of meetings of superintendents of schools and principals was conducted by the State Department of Education throughout the state to acquaint schoolmen with the operation of the various titles of the National Defense Education Act. A part of each of these meetings was devoted to an explanation of the Title VII project, an appeal for participation, and an opportunity for questions.

Announcements concerning the project were mailed regularly to all of the daily newspapers of the state, and to all of the radio and television stations. With the cooperation of a staff writer, a feature story was published in the only Sunday newspaper in the state. The project director also described the program on the radio and on television.

Ten thousand brochures containing a brief description of the project, its purposes, the nature of the two courses, and the names of project staff and advisory committee members, were printed and distributed. Copies were mailed to presidents of the various service clubs, fraternal and social and professional organizations, and to parent teacher club officers in almost every community in the state. Enclosed with the brochures were letters offering to provide additional information upon request. Copies also were sent to principals and superintendents for use in publicizing the program locally.

The project director and several other members of the Department made personal visits to superintendents and principals to point out the value of participation. These persons also made many telephone calls for the same purpose.

The reduction in the number of participating schools during the second year, in the opinion of those responsible for conducting the project, was due in part to the fact that the same intensive campaign was not conducted in the spring of 1960. The project director erred in believing that principals would enroll their pupils merely because of the demonstrated high quality of the two courses. It now seems apparent that intensive, persistent, organized efforts to encourage schools to use educational television will always be needed until such use becomes habitual.

Schedule difficulties. School schedules are a real obstacle to use of televised programs. The courses were televised only once daily, one from 9:00 to 9:30 A.M., and the other from 9:30 to 10:00 A.M. In some few schools this hour coincided with a class period. In some schools one of these half-hour periods began at the same time as a regular class period; in others it ended at the same time as a class period; in others it fell between the limits of a class period; in the great majority of schools at least one of the televised courses overlapped two class periods.

As a result, special provision had to be made in most schools to release students from a regular class before the period had ended and to admit others to a class after it had started. This was a source of irritation to many teachers, and obviously affected their attitude toward the program.

Provision also had to be made to supervise the pupils who had spare time before or after the televised half-hour. This was an additional burden upon principals.

Many of the pupils who would profit-most from the program were scheduled for essential courses in their own schools between nine and ten o'clock. Some principals stated that it was not possible to rearrange their class schedule to free the pupils at this time. To demonstrate that this was not true, two members of the State Department of Education developed a schedule for two schools, one large and one small, whereby this problem could be solved. Copies of these two schedules were sent to each secondary-school principal.

One problem to which there was no really satisfactory solution was caused by the fact that most of the small schools in Maine have a rotating schedule. As a result, most students encountered once a week a conflict between the televised courses and each regular subject taught by teachers in his school. In most instances this problem was resolved by excusing the student from his regular class in order to permit him to view the televised course.

Variation in pupil load. Another factor which not only produced a variable for the research pattern but also created a real obstacle to successful participation was the effort by many school administrators to schedule the televised courses in addition to a full load of regular courses. Almost every conceivable pattern of course load was attempted, with some pupils scheduled for two regular subjects plus two televised co[illegible], and with others enrolled in five or six regular courses with two or one televised courses respectively.

Most of the Maine secondary schools which are recognized as above average in quality generally enroll pupils of the caliber for whom the Nine O'Clock Scholar was designed in not more than five academic subjects per year. The televised courses were designed to challenge the best efforts of these pupils. Permitting some students to attempt seven academic subjects, including one or both of the televised courses, placed what seems to be an excessive burden upon them which seemed likely to result in reduced achievement in either the experimental courses or the regular school subjects.

Quality of televised courses. The prime teaching problem, recognized alike from the very beginning by both the project administrators and the teachers, was the production of courses of really high quality. Primarily in order to obtain as high quality as possible, extensive use was made of advisory committees in both subjects. These committees were made up of college and secondary-school teachers of mathematics and science who were recognized as leaders in their fields.

Very careful and detailed preparation was made for the teaching of each lesson. It was originally planned that the three assistant teachers would assist the television teacher in their spare time, but that their major responsibility would lie in school visitations and seminars. It soon became clear, however, that this arrangement would result in the consumption of programs faster than the master teacher could prepare them.

The first step taken was to assign one of the assistant teachers to work full-time with the master teacher. When it became clear that this was still inadequate, the other two teachers were assigned to work with him two days per week, and to do field work only three days per week. This step was taken because, although there was danger that there would not be enough visitations or seminars, it was believed that the quality of the televised courses must be maintained regardless of the cost to other phases of the research.

Even under this arrangement, the staff worked long hours, particularly during the first half of each year. The typical working day was ten to twelve hours in length, and the staff generally worked at least six days each week.

Commercial television facilities. There are six commercial television stations in Maine. Channel 8—WMTW-TV —transmits from Mt. Washington, and covers a large part of Maine, New Hampshire, and a part of Vermont. Channels 6 and 13—WCSH-TV and WGAN-TV—cover the Portland area. Channels 5 and 2—WABI-TV and WLBZ-TV—blanket the Bangor area. Channel 8—WAGM-TV—covers the major part of Aroostook County, and is an affiliate of Channel 5 in Bangor. The viewing area of Channels 6 and 13 in Portland overlaps much of that of Channel 8 from Mt. Washington.

Channel 8 in Presque Isle is equipped to pick up through relay stations and to rebroadcast signals from the two Bangor stations. The two Bangor stations can re-broadcast signals from the two Portland stations. The signal cannot, however, originate in Presque Isle or Bangor and be transmitted south or west for re-broadcast.

For these reasons the two Portland stations were each asked to provide facilities to originate one course, with the two Bangor stations each carrying a simultaneous telecast, and with the Presque Isle station carrying both of them. The Mt. Washington station was not invited to participate.

When first approached, the management of the two Portland stations were reluctant to commit their stations for 175 days for a half-hour per day. They were concerned about the probable loss of a viewing audience which they had learned might take several hours to recover. They had to be answered that there had been adequate planning, that the quality of the program would be likely to be high, and that a sufficient number of schools would be likely to take part.

Review of the original draft of the research proposal submitted to the Office of Education assured the studio management that there had been adequate planning and that the quality of the program would be likely to be satisfactory. Advance registration totals in the spring of 1959 provided evidence that there would be a school audience of sufficient size. Consequently, all five stations agreed to carry the program.

One matter difficult to agree upon was the time of the telecasts. In 1959 the hours made available most easily were 9:00-10:00 A.M. and 1:00-2:00 P.M. The television stations would have preferred to schedule one course in the morning and the other in the afternoon. This would have increased substantially the scheduling problems of most schools, and actually would have resulted in one program being telecast after the close of the regular session in some schools. After lengthy negotiation it was finally agreed that the two courses would be scheduled for two consecutive half-hours between 9:00 and 10:00 A.M.

These problems were much easier to resolve for the second year, partly because the television stations were satisfied with the ability of the program to hold adult audiences as revealed in program rating reports. Another factor which was of immeasurable help was the employment of a person with experience in commercial television and with wide contacts in the field who served as liaison between the project staff and the television stations.

Staff recruitment. This presented some unexpected problems. It was recognized from the beginning that the quality of the program would vary in direct proportion to the caliber of the staff, and every effort was made to recruit the best available persons. All of the normally used employment agencies in Maine, and some in New Hampshire and Massachusetts were utilized.

It was expected that many apparently well qualified persons who were employed beyond commuting distance from Portland would be reluctant to move to that city to be part of a project that might last only one year. It would have been easier to recruit personnel if the programs could have originated in Bangor as well as in Portland.

The salaries offered to project employees were higher than those ordinarily paid to Maine teachers. It seemed obvious that the project employees would experience an in-service learning program that would be difficult to duplicate, and if the project were successful, that they would establish a state-wide reputation that would aid their careers. Nevertheless, many apparently well qualified teachers were very reluctant to join the staff. There seemed to be a general hesitancy about exchanging the security of a classroom teaching job which they knew they could handle comfortably for the challenging task of building a new course and presenting it through, to them, an untried medium, however attractive the rewards might be. As a result, it required the best efforts of many people to complete a really competent staff.

At the end of the first year, five of the nine staff members accepted National Science Foundation academic year fellowships. The task of recruiting capable replacements was made easier by the one-year demonstration that the two courses could be taught successfully by television.

Adjustment to TV teaching. None of the teaching staff had had any previous television experience. In learning how to use this different medium for effective teaching, many adjustments had to be made.

The program directors and the staff TV coordinator advised the teachers concerning such matters as dress, deportment before the camera, techniques in preparing materials and equipment for effective use, timing of the lesson, use of "idiot cards," voice modulation, and facial expressions. Before each school year began, and during the first few weeks, detailed scripts were prepared for each lesson and were reviewed by the TV coordinator and station staff members. Each lesson was carefully rehearsed with the assitance of these persons. As the teachers acquired experience, the scripts became less detailed and studio rehearsals were confined to those features of the lessons which seemed likely to cause viewing difficulties.

Pupil-teacher communication. The most serious problem encountered by the television teachers was caused by the inability of the teacher to see his students. The teachers missed the face-to-face contact with their students in a regular classroom, where the attitude of the pupils and their facial expressions help to adjust teaching to the needs of the class. The teachers missed also the opportunity for pupils to ask questions and to clarify points immediately. It was very difficult to know whether or not the lesson content was too complex or too simple, the pace was too rapid or too slow, whether or not the students were interested, were completing assigned work, or even were viewing the program. (It was reported that in one unsupervised classroom the students occasionally changed the dials to watch "Romper Room," a popular program for young children.)

The first year, postal cards were sent to each school for return to the television teachers. A mimeographed form on the reverse side of the card was a three-point rating scale on the pace of teaching, the difficulty of the content, the speaking rate, the clarity of explanations, and the amount and adequacy of presentation of assignments. The local coordinators were asked to complete the evaluations after consultation with the students, and to return the postal cards on Friday of the first four weeks.

The response was excellent, but the data obtained were of little value. The number of schools which rated the presentation as too rapid or as clear was almost exactly equal to the number of schools which rated the same presentation as too slow or vague. In almost all instances the number of schools which gave a middle rating was slightly larger than either of the other two groups of responses for each item.

Inquiries made by assistant teachers in personal visits to the schools produced the same results. Analysis of letters from adult viewers, especially from teachers and former teachers, yielded the same lack of concensus.

Finally, it was arranged that assistant teachers would view the program in classrooms with participating students. For most of the first year and almost all of the second year, there was an average of ten such observations each week. Through observation of the reactions of the pupils and through questioning immediately after the lesson, these assistants were able to gauge fairly satisfactorily the strengths and weaknesses of the television lessons and to feed back their suggestions to the teachers without delay.

Psychological effects of TV teaching. Especially during the first part of each year, the teachers experienced tension because they did not know who, in addition to those officially enrolled, were watching any given lesson. They realized that they were competent teachers, but they also were aware that there might be in the viewing audience persons who possessed greater depth of preparation in the subject matter presented. Actually there were college professors of mathematics and science who watched the program with varying regularity, and many of them wrote to the television teachers. Most of the comments were friendly and constructive, but a few were caustically critical.

The teaching to which the staff members were accustomed involves a highly personal interaction between the teacher and his pupils. The television teachers felt that they were teaching an impersonal machine, the television camera. This created tensions that persisted throughout the year and were alleviated only by the regular feedback through the assistant teachers and through correspondence. Partly because of the impersonality of the situation, the television teaching had a tendency to become stereotyped and stiff. The teachers were aware of this tendency, and overcame it with varying degrees of success.

The teachers were aware that even television teachers of the stature of Dr. Harvey White occasionally were guilty of misstatements. Probably all teachers from time to time in ordinary classroom teaching make inaccurate statements. Sometimes these are corrected by a student. In any event, neither teacher nor pupil pays much attention to it unless it occurs too frequently. The television teachers made constant and persistent efforts to avoid errors, even slips of the tongue, because they felt that the error would be magnified by the size of the audience. This unnatural alertness further increased the burden of teaching.

Time limitations. Each lesson was exactly 28½ minutes in length. Consciousness of the need to complete the daily presentation within this limited time segment, and of the need of making each lesson at least to some extent, a discrete entity with a logical ending added to the mental pressures upon each teacher.

Variations in school vacations. Among Maine secondary schools there are wide variations in the dates of vacation periods. The schools in Aroostook County begin school the last week in August and have the " potato vacation," previously alluded to, during the last two or three weeks in September and the first week in October.

The majority of schools open during Labor Day week, have one or two weeks of vacation the last of December, one week during the week of February 22, one during the week of April 19, and close early in June. Almost all schools have a recess during the last week in December and the week in February in which February 22 occurs. The reason for the uniformity in the February vacation is that the state basketball tournaments are scheduled during this week.

The project personnel wanted to schedule the televised courses for as long a period as possible within the school year because each course carried one Carnegie credit. They wanted to avoid insofar as possible telecasts on days when schools were not in session, because of the lack of supervision of students who viewed the program in their own homes. On the other hand, they did not want to have school in session too long during the year without televised lessons.

Because of these considerations, there were 175 televised lessons each year, beginning the second Monday in September and ending on the first Friday in June. Vacation periods consisted of the last full week in December, the week of February 22, and November 11, 26 and 27, January 1, and May 30.

Students whose schools were closed when lessons were being televised were urged to watch the program at home. Also, during the next to the last week in December and during the most popular vacation week in April, the pace of instruction was slowed. Part of the time was used for review, a part for extended teaching of a topic already being discussed, and a part for the presentation of films especially chosen to give additional insight into the concepts presented.

When the program was not being presented, films related to science or mathematics were shown by the station staff. The films were obtained by project personnel for use as sustaining programs in order to prevent inconvenience to the stations.

Generalizations Concerning Inherent Problems of TV Teaching

Quality of teaching. After two years' experience, the project staff is convinced that to be successful, televised courses must be of very high quality. The television teacher must have a thorough knowledge of the subject, and should have sufficient knowledge of related subject matter disciplines to be able to point out relationships. He must know the learning potentialities of his students, and be able to adjust the course to fit their traits. As in any teaching situation, the more he learns about his students, the more effective a teacher he can be.

The television teacher must have adequate time for preparation to teach. In experimental courses such as these, the units of which were built as the year progressed, a full-time teacher needs the assistance of at least one and preferably two full-time professional assistant teachers.

The television teacher must have a warm, friendly personality which he can project on the screen. His voice should be pleasant and well modulated. His presentation should appear relaxed, yet authoritative.

In live television the teacher must have excellent health, because the use of substitutes usually interferes somewhat with the sequence of teaching. He must be free from major economic or family problems, because they will reduce his efficiency. He must possess sufficient self-discipline to overcome the tensions caused by television teaching.

Almost all of these factors in achieving high quality in teaching through television apply as well to all classroom teaching. Nevertheless, they are essential to the success of educational television, partly because ETV is a relatively new medium for teaching and must compete with the best of classroom teaching, partly because of the inherently impersonal nature of teaching through a machine, partly because of the inconveniences and limitations imposed by time schedules. American education has accepted and probably will continue to accept lower standards of excellence for classroom performance than it will for television teaching.

Program selection. Educational television programs will be accepted and used only when administrators and teachers in receiving schools are convinced that they have a genuine need for the program sufficiently great to compensate for the effort required to use it. Educational television will not succeed merely because the quality of teaching is high, or because through television certain presentations can be made that are impracticable or impossible in the regular classroom, or even because there is a genuine need for the program.

The project staff is convinced that both the administrators and teachers in the schools served by educational television must be consciously aware of the advantages to them and to their pupils of a particular program, and as a result truly want to use it. It would appear that to succeed, those responsible for producing educational television need (1) to know that the school personnel in the area to be served are aware of the potential value of E[illegible]ssuming responsibility to develop this appreciation, if necessary), (2) to learn what the schools want and would use, [illegible] (3) to provide these wanted programs and services.

School schedules. The class schedules in secondary schools present problems that are difficult to resolve. Particularly is this true in schools with rotating schedules. Although it is difficult, schedules can be adjusted in almost every school to permit pupils to use televised programs. Sometimes principals need assistance in schedule rearrangement. At other times it is necessary to convince principals that the rearrangement of the schedules of large numbers of students is desirable for the benefit of a small number who will receive televised instruction.

Another problem occurs when a teacher has several class sections in the same subject and would like to have several or all of them have the benefit of the televised program. Sometimes it is practicable to assemble these classes in a large room for the single telecast. On a small scale this was done in the Nine O'Clock Scholar program, when students from several classes in the same school participated.

Although it was not possible on the commercial stations which carried the experimental courses, it would appear that another partial solution on ETV stations would be a taped re-telecast of the same program at one or two different times during the school day. This arrangement was proposed by the Twenty-One Inch Classroom for use with some programs on educational station WGBH-TV, Channel 2, in Boston.

Cost factor. It seems futile to attempt to be specific in analyzing the cost factor in producing and teaching the Nine O'Clock Scholar courses for gifted students. More personal services were provided for some of the students than would be in regular practice. The standardized testing program used to measure the effectiveness of the program was expensive, and would not ordinarily be used. A full-time person was employed to conduct the testing program. Most of the cost of televising was absorbed by the television stations as a public service. Almost all of the teaching equipment and materials were borrowed at no cost. These and other lesser extra expenditures and savings cause an analysis of the actual costs to be unrealistic in terms of what might normally be expected

There are, however, a few observations which it would appear appropriate to make.

The average per-pupil expenditure in Maine secondary schools in 1959-1960 was $374.89. Assuming that each pupil was enrolled in five subjects, the average cost for each subject per pupil was $74.98.

The only expenses to participating schools were the provision of a television receiver, postage for returning tests, and approximately $10.00 per student per year for textbooks. Theoretically, schools were contributing the salaries of the local coordinators and defraying transportation costs for students to attend seminars. In actual practice, however, the coordinators assumed their duties as an additional responsibility, and the transportation expenditures by most schools were negligible.

The net monetary value to each school in terms of average local costs for regular subjects appears to have been approximately $65.00. A total of 234 pupils was considered officially to have completed Concepts of Mathematics I; and Space Age Science I, 199. The total net monetary value to the participating schools for these pupils can thus be estimated to have been 433 x $65.00. or $28,145.

The total project expenditures for all purposes for the project through June 30, 1960 were $88,467.40. Obviously, an enrollment of 1,361 pupils, each in one course, or of 681, each in two courses, would be required to reach a " break-even " point compared with conventional classes, provided costs for course production and services remained constant.

Only 65 of the 181 schools within the television viewing area participated in the project in 1960-61. Participating schools generally enrolled fewer than the total number of eligible pupils. It seems reasonable to assume, consequently, that programs similar to the Nine O'Clock Scholar are economically feasible.

Studio facilities. For effective teaching a television studio should be large enough to permit efficient arrangement of the equipment and materials the teacher will use. There should also be sufficient area for the studio staff and for easy movement of the cameras. A spacious studio area reduces the claustrophobic effect experienced by some teachers. It also permits enough freedom of movement to relax the teacher perceptibly.

There should be two cameras. There are several advantages in having a second camera. It will permit instantaneous changes from close-up to long range views; it provides variation for the viewer in the vantage point from which he sees the teacher; it relieves the teacher of much memory work when he reads off camera while the other camera is focused on the set.

Preparation of visuals. Careful planning as far in advance as possible is necessary for the preparation of special visuals, such as pictures, charts, graphs, and three-dimensional models. Care must be experienced to ensure that legends can be read easily on receiver screens. Provision must be made to reduce glare. Preferably, the construction of these materials should be assigned to qualified specialists.

APPENDIX A

Statistical Analyses Techniques

To assist the reader in interpreting and evaluating the statistical analyses employed in this study, the following materials are included in this Appendix:

1. An explanation of the reasons for using the analysis of covariance technique and a brief description of how it was applied
2. Tables of means and standard deviations of scores for all controls and variables measures used in the analyses of covariance
3. One sample intercorrelation matrix of complete-data cases for each of the two years, and
4. Tables of means, medians, standard deviations, and distributions of scores on the staff-constructed unit and end-of-course achievement tests.

Analysis of Covariance

In experiments in which two or more groups receive different treatments, it would be greatly desirable for the groups to be identified at the start. If they differ before the treatments, then differences found after the treatments might be due to the initial differences and not to the treatments.

Since it is usually impossible to find identical groups, some common but less desirable procedure must be used. Large groups can be selected randomly from a single population; these groups would differ only by chance, but at times chance differences are large. Another procedure would be to use some other method of sampling, measure all the groups on some highly related variable or variables, and then select individuals within each group to form subgroups which are equivalent on the " control " variables. This, too, has drawbacks in that (1) the control variables may not be closely related to the traits on which the groups should be equated, (2) the selection process is wasteful in that it doesn't use all of the available subjects, and (3) naive experimenters may not know about the regression effect, and so may equate on the basis of actual scores rather than regressed scores. Of course, if membership in groups is not predetermined, the individuals can be allotted among the groups on the basis of their control variable scores.

A third technique is to use the samples as they are, and then to use a statistical correction for differences among the groups on the pretreatment variables. This again depends upon the adequacy of the pretreatment control variables, and complete dependence on statistical correction of initial differences among groups should be avoided when possible.

A combination technique is usually preferred. Samples may be drawn randomly but pretreatment measures are used in addition. The relationships of the pretreatment measures with the post-treatment measures are then used so that the groups are not compared on only raw differences after treatment. Instead they are compared on a type of gain, and this is a more sensitive measure of change due to treatment. This is often done by giving the criterion measure before treatment and again afterwards. The difference in these two scores for each individual is a measure of gain, and average gains can be computed for the treatment groups. If the criterion measure cannot be used as a pretest, it is often possible to use a measure which is related to it in some way, often a measure which predicts scores on the criterion measure. In this situation, a type of predicted score is obtained from the premeasure, and the criterion score is compared with that predicted score. This provides a type of gain score and the treatment groups can be compared with respect to whether one treatment showed more gain from the predicted scores than did the others. Often two or more pretests are used to predict the criterion scores so as to make the " gain " as pure as possible — if the relationships between the predictors and the criterion are not very high, they do little to reduce (purify) the unpredicted variance of the criterion scores.

The gain technique has an additional desirable aspect. Not only are the gain scores desirable for the individuals, but the group averages on the predictors are also used to predict the group averages on the criterion. Thus if the groups are not equated on the initial predictor measures, the predicted averages will vary and group means on the criterion may be " adjusted " by using the portion predicted for each group. For example, if a low ability group and a high ability group are taught by different methods, they may achieve nearly identical scores on the achievement measure (criterion). Obviously, the predicted achievement for the low ability group would have been less, so they made more gain from their treatment than did the other group from theirs. This technique would show that the adjusted mean achievement for the low ability group was higher than that for the high ability group even though the actual mean achievement scores were practically identical.

In the present study, because of geographic factors, it was impossible that the sampling be completely random, but even if the sampling had been random, the covariance technique would have been used. This technique not only applies some corrections toward equating the groups when there is a bias in the selection, but it also equates somewhat for the differences due to chance in random sampling. When standard measures were used as criteria (the STEP and FAS) it was possible to use the same measures as pretests so that gain scores could be obtained. These gain scores were further purified by using predictors as pretests (for example, the two SCAT scales). For the unit and final tests which could not be given as pretests, the STEPS were used as additional predictors. Thus this was fairly sensitive to differences in treatments, since a fairly random selection technique was used, predictors were used for all comparisons, and direct gain was used for the standard measures. The analyses of covariances were then analyses of the residual variance after the amount of variance predicted by the control variables had been removed. Because the control variables were fairly well related to the criterion measures, the means were in many cases adjusted appreciably.

It is usually desirable and efficient to use fewer control variables — it is seldom that additional variables after three add anything useful to the prediction — but no attempt was made to reduce their number. It would have been desirable to use separate analyses for the students in different grades in high school, but this did not seem practicable, considering the sizes of the samples.

Controls and Variables for Analyses of Covariance in All Courses

TABLE A. Means and Standard Deviations of Scores by Treatment Groups and for Entire Group in Concepts of Mathematics I

	Test		Television Only	Visits	Seminars	Visits and Seminars	All Students
CONTROLS	Pre-test SCAT Verbal	Mean	298.7706	299.1831	303.2941	302.8649	299.8718
		S.D.	12.9803	15.8695	10.2714	9.3089	13.3880
	Pre-test SCAT Quantitative	Mean	316.8348	317.1831	316.5882	313.4595	$316.388\overline{8}$
		S.D.	11.4983	10.1736	11.1727	8.7968	$10.76\overline{74}$
	School Personnel Attitude Rating	Mean	2.6422	2.2676	2.6471	1.8378	2.4017
		S.D.	1.2379	.6270	.5882	.3686	.9833
	Number of Mathematics Courses	Mean	1.3853	1.4648	1.2353	1.4865	1.4145
		S.D.	.6483	.5773	.8065	.4998	.6229
	Pre-test STEP Mathematics	Mean	294.6422	295.4507	298.2941	293.3784	294.9530
		S.D.	$11.208\overline{2}$	11.1353	5.3442	10.6399	10.8369
VARIABLES	End-of-Course Test	Mean	72.1559	76.4366	77.0	$81.\overline{378}$	75.2649
		S.D.	8.8754	9.4938	8.9443	9.8072	9.8035
	Unit Test — (Logic and Set Theory)	Mean	134.6055	147.1831	144.4118	159.4054	143.0555
		S.D.	31.9472	30.4424	20.5657	24.6450	31.0517
	Unit Test — (Number Theory)	Mean	139.8349	151.1268	154.8235	166.1351	148.5513
		S.D.	28.9084	26.4356	22.9224	20.6399	28.2175
	Unit Test — (Probability)	Mean	69.9541	74.3662	73.1176	$77.\overline{297}$	72.68376
		S.D.	10.5233	11.6368	11.0500	10.7045	11.2858
	SUYSS	Mean	22.9032	20.8966	20.4000	19.8276	21.7243
		S.D.	5.7456	6.0306	5.1614	4.8854	5.8295
	STEP Gain from Fall to Spring	Mean	3.2804	3.9516	$5.\overline{09}$09	$3.9\overline{189}$	3.6728
		S.D.	9.0964	$9.343\overline{6}$	9.7836	$14.529\overline{3}$	10.3344

NOTE: In all analyses of covariance, the Pre-test SCAT Verbal, Pre-test SCAT Quantitative, and School Personnel Attitude Ratings are used as control variables. The Pre-test STEP Science scores were used in all analyses except STEP Gain. The number of courses in trigonometry was used in the Concepts of Mathematics II analyses, and the number of courses in physics was used in analyses of both Science for the Space Age courses.

TABLE B. Means and Standard Deviations of Scores by Treatment Groups and for Entire Group in Concepts of Mathematics II

	Test		Television Only	Visits	Seminars	Visits and Seminars	All Students
CONTROLS	Pre-test SCAT Verbal	Mean	301.9857	299.3258	300.0526	296.2500	300.0986
		S.D.	12.2317	12.2582	11.7360	14.8219	12.4725
	Pre-test SCAT Quantitative	Mean	319.2428	314.9775	323.2631	311.50	317.5962
		S.D.	10.2057	12.1682	9.9172	12.2474	11.1713
	School Personnel Attitude Rating	Mean	2.4143	1.6517	2.2895	1.8125	2.0282
		S.D.	.5974	.6721	.4535	.3903	.6914
	Number of Mathematics Courses	Mean	1.7857	1.7753	1.8421	1.8750	1.7981
		S.D.	.6523	.4916	.4308	.5995	.5495
	Pre-test STEP Mathematics	Mean	295.8143	292.2697	298.5000	290.6250	294.4225
		S.D.	10.2919	10.9757	8.5494	8.2906	10.4867
VARIABLES	End-of-Course Test	Mean	73.7714	78.3933	84.0263	76.3125	77.7230
		S.D.	15.9787	11.2136	11.3311	10.7280	13.4372
	Unit Test — Trigonometry	Mean	154.7714	155.2472	169.8684	155.250	157.6995
		S.D.	23.4424	21.8042	18.7409	16.6752	22.2486
	Unit Test — Matrices	Mean	159.1143	166.9663	174.0789	167.3750	165.6854
		S.D.	24.1954	17.2558	19.5911	14.5597	20.7090
	Unit Test — Set Theory	Mean	75.6429	81.2472	84.5526	72.250	79.3192
		S.D.	13.3310	9.8120	10.6862	10.3773	11.9050
	SUYSS	Mean	$20.68\overline{3}$	21.5349	$22.\overline{03}$	$21.\overline{3}$	21.3402
		S.D.	5.0908	5.1006	4.4754	7.1616	5.2108
	STEP Gain from Fall to Spring	Mean	5.1176	4.0617	5.2368	$3.1\overline{3}$	4.5693
		S.D.	8.3340	9.7275	8.0375	9.5838	8.9856

N.B. See "Note" under TABLE A.

TABLE C. Means and Standard Deviations of Scores by Treatment Groups and for Entire Group in Science for the Space Age I

	Test		Television Only	Visits	Seminars	Visits and Seminars	All Students
CONTROLS	Pre-test SCAT Verbal	Mean	298.276	299.860	298.750	302.538	$299.5\overline{90}$
		S.D.	12.111	11.363	13.945	7.855	11.894
	Pre-test SCAT Quantitative	Mean	312.948	311.674	312.607	316.384	$312.\overline{79}$
		S.D.	12.182	11.786	12.582	9.735	11.869
	School Personnel Attitude Rating	Mean	2.259	2.325	2.250	3.231	2.414
		S.D.	.658	.895	.688	1.423	.954
	Number of Science Courses	Mean	1.258	1.244	1.036	1.462	1.247
		S.D.	.684	.369	.680	.634	.639
	Pre-test STEP Science	Mean	297.276	292.011	291.428	300.577	$294.\overline{59}$
		S.D.	12.018	33.524	12.832	.958	24.019
VARIABLES	End-of-Course Test — Physics	Mean	61.750	60.532	58.286	62.038	60.770
		S.D.	15.291	13.720	5.828	8.492	13.523
	Unit Test — Geology and Earth Science	Mean	31.034	30.546	32.214	33.269	$31.\overline{28}$
		S.D.	7.701	7.939	8.347	4.109	7.597
	Unit Test — Chemistry	Mean	75.345	78.488	72.642	79.846	$76.\overline{91}$
		S.D.	23.034	21.504	24.092	15.839	21.836
	Unit Test — Biology	Mean	22.517	22.546	22.964	23.692	$22.\overline{74}$
		S.D.	5.120	5.874	5.571	4.409	5.456
	SUYSS	Mean	22.340	$21.\overline{5}$	24.150	22.846	22.297
		S.D.	5.175	5.230	5.111	4.092	5.108
	STEP Gain from Fall to Spring	Mean	9.070	8.807	5.678	8.654	8.412
		S.D.	11.619	10.136	13.928	10.546	11.305
	FAS Part I	Mean	$1.33\overline{3}$	1.361	1.678	.423	1.159
		S.D.	.314	.292	.307	2.857	.306
	FAS Part II	Mean	1.1614	2.373	3.643	.423	2.072
		S.D.	2.845	3.518	3.607	3.864	3.517

N. B. See "Note" under TABLE A.

TABLE D. Means and Standard Deviations of Scores by Treatment Groups and for Entire Group in Science for the Space Age II

	Test		Television Only	Visits	Seminars	Visits and Seminars	All Students
CONTROLS	Pre-test SCAT Verbal	Mean	$301.\overline{09}$	296.457	$299.0\overline{6}$	304.285	299.120
		S.D.	19.009	14.013	12.358	11.157	14.458
	Pre-test SCAT Quantitative	Mean	312.000	309.857	309.60	319.142	311.853
		S.D.	12.785	14.679	14.463	8.096	13.835
	School Personnel Attitude Rating	Mean	$2.\overline{54}$	2.200	$2.46\overline{6}$	2.928	2.440
		S.D.	.782	.466	.499	1.032	.716
	Special Preparation	Mean	$.\overline{45}$	.428	$.46\overline{6}$	.357	.426
		S.D.	.498	.495	.499	.479	.494
	Pre-test STEP Science	Mean	$298.\overline{27}$	294.571	$300.2\overline{6}$	303.000	$297.82\overline{6}$
		S.D.	12.555	14.867	12.309	13.464	14.198
VARIABLES	End-of-Course Test — Physics	Mean	$64.9\overline{0}$	67.228	$68.1\overline{3}$	73.071	68.160
		S.D.	10.732	18.569	11.960	10.653	15.298
	Unit Test — Astronomy	Mean	18.000	19.742	18.786	21.786	19.689
		S.D.	2.449	7.015	5.453	5.073	6.006
	Unit Test — Propulsion	Mean	$17.\overline{09}$	19.371	18.785	25.000	19.986
		S.D.	5.107	6.748	5.427	18.822	10.221
	Unit Test — Electronics	Mean	$21.\overline{90}$	27.829	26.000	30.286	27.067
		S.D.	5.401	8.833	10.212	5.624	8.565
	SUYSS	Mean	$22.\overline{81}$	20.931	20.857	$25.1\overline{6}$	22.000
		S.D.	4.509	6.464	6.334	4.159	6.010
	STEP Gain from Fall to Spring	Mean	1.000	5.448	1.250	$.\overline{90}$	2.306
		S.D.	8.602	10.391	9.670	11.325	10.605
	FAS Part I	Mean	.200	.689	$.66\overline{6}$	$.\overline{63}$	.5323
		S.D.	4.874	4.504	3.815	2.346	4.149
	FAS Part II	Mean	1.300	1.483	$1.6\overline{66}$	$1.\overline{81}$	1.129
		S.D.	5.797	3.927	2.427	3.325	4.109

N.B. See "Note" under TABLE A.

INTERCORRELATION MATRIX OF COMPLETE-DATA CASES IN SCIENCE FOR THE SPACE AGE I (N=164)

	1	2	3	4	5	6	7	8	9	10	11				12			
	Interest	Load	School Attitude	Grade	Preparation	Special Preparation	SCAT Verbal	SCAT Quantitative	Pre-STEP	Post-STEP	Test 1	Test 2	Test 3	Test 4	Pre-FAS	Post-FAS	Pre-FAS	Post-FAS
1. Interest	—	.05	.04	.04	.06	.17	.00	.08	-.14	-.09	-.22*	-.20*	-.24*	-.16	-.07	-.10	.04	.03
2. Load	.05	—	.24*	-.13	-.14	.04	.20*	.17	.16	.17	.19*	.09	.17	.16	.19*	.12	.24*	.20*
3. School Attitude	.04	.24*	—	.03	.00	.19*	.11	.14	.20*	.03	.12	.14	.16	.11	.17	-.01	.18	-.04
4. Grade				—	.84*	.25*	.18	.06	.29*	.23*	.16	.02	.30*	-.04	.10	.11	.10	.10
5. Preparation				.84*	—	.18	.12	.09	.30*	.23*	.17	.04	.27*	-.02	.12	.09	.13	.12
6. Special Preparation				.25*	.18	—	.11	.10	.23*	.26*	.18	.18	.09	-.01	.05	-.03	.19	.01
7. SCAT Verbal							—	.26*	.51*	.48*	.49*	.42*	.44*	.40*	.59*	.52*	.59*	.56*
8. SCAT Quantitative							.26*	—	.42*	.40*	.40*	.31*	.33*	.16	.25*	.23*	.17	.10
9. Pre-STEP							.51*	.42	—	.71*	.71*	.56*	.63*	.37*	.47*	.43*	.46*	.48*
10. Post-STEP							.48*	.40*	.71*	—	.68*	.50*	.55*	.25*	.39*	.46*	.41*	.40*
11. T-1 End-of-Course—Physics											—	.72*	.73*	.47*	.44*	.41*	.32*	.26*
T-2 Geology and Earth Science											.72*	—	.66*	.41*	.29*	.35*	.31*	.29*
T-3 Chemistry											.73*	.66*	—	.43*	.40*	.42*	.31*	.36*
T-4 Biology											.47*	.41*	.43*	—	.26*	.29*	.15	.22*
12. Pre-FAS Scale 1															—	.61*	.50*	.39*
Post-FAS Scale 1															.61*	—	.45*	.61*
Pre-FAS Scale 2															.50*	.45*	—	.60*
Post-FAS Scale 2															.39*	.61*	.60*	—

INTERCORRELATION MATRIX OF COMPLETE-DATA CASES IN CONCEPTS OF MATHEMATICS II (N=188)

	1	2	3	4	5	6	7	8	9	10	11			
	Interest	Load	School Attitude	Grade	Preparation	Special Preparation	SCAT Verbal	SCAT Quantitative	Pre-STEP	Post-STEP	Test 1	Test 2	Test 3	Test 4
1. Interest	—	-.04	-.05	.09	-.03	-.01	.13	-.08	-.19*	-.21*	-.39*	-.30*	-.35*	-.23*
2. Load	-.04	—	-.22*	-.24*	-.02	.04	.18	.10	.09	.18	-.02	.01	.00	.00
3. School Attitude	-.05	-.22*	—	-.01	.00	-.06	-.02	.04	.11	.06	-.07	-.07	-.12	-.08
4. Grade				—	.61*	.48*	.25*	-.02	.12	.02	.17	.26*	.22*	.18
5. Preparation				.61*	—	.51*	.37*	.24*	.29*	.27*	.24*	.34*	.23*	.29*
6. Special Preparation				.48*	.51*	—	.35*	.38*	.43*	.41*	.30*	.50*	.26*	.28*
7. SCAT Verbal							—	.32*	.40*	.39*	.26*	.36*	.16	.27*
8. SCAT Quantitative							.32*	—	.62*	.61*	.49*	.56*	.37*	.42*
9. Pre-STEP							.40*	.62*	—	.62*	.51*	.61*	.39*	.41*
10. Post-STEP							.39*	.61*	.62*	—	.58*	.59*	.45*	.43*
11. Test 1—End-of-Course											—	.78*	.74*	.68*
Test 2—Trigonometry											.78*	—	.68*	.62*
Test 3—Matrix Algebra											.74*	.68*	—	.61*
Test 4—Set Theory											.68*	.62*	.61*	—

Means, Medians, Modes, Standard Deviation, and Distributions of Scores on Staff-Constructed Unit and End-of-Course Achievement Tests

CONCEPTS OF MATHEMATICS I
1959-1960
TEST DATA

Per Cent Right	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Final
90-100	18%	23%	18.8%	19.4%	18.5%	9.5%	10.1%	9.1%
80-89	31	14	16.4	25	23.5	17.8	19.2	23.8
70-79	22	20	16.4	26.6	15.5	40.0	42.8	38.5
60-69	16	17	23.2	12.5	19.5	23.5	18.3	22.1
50-59	13	11	8.8	9.7	13.9	Below 60	Below 60	6.5
Below 50		15	16.4	6.8	9.1	8.2	9.6	
Mean	79	73.1948	70.3030	75.8	73.1783	73.7706	77.2174	75.3621
Median	79	73	70	76	75	72	74	78
Mode	84	91	80	76	84	60, 72	73	75, 77
Standard Deviation	—	16.96	18.18	14.08	16.37	10.32	13.29	9.78

CONCEPTS OF MATHEMATICS II
1960-1961
TEST DATA

Per Cent Right	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Final
90-100	16.9%	22.4%	22.6%	24.1%	23.4%	47.7%	22.5%	21.0%
80-89	33.7	25.8	25.4	28.5	22.5	28.1	28.4	30.4
70-79	23.0	29.6	24.9	28.0	28.9	13.6	25.0	24.8
60-69	16.4	14.2	15.8	15.1	14.6	6.3	20.1	12.6
50-59	5.2	6.4	6.3	4.3	9.6	2.9	4.0	8.4
Below 50	4.8	1.6	5.0	—	.9	1.4	—	2.8
Mean	77.09	79.4159	77.4360	80.4558	78.3692	86.7905	79.1848	77.7619
Median	80.5	78.2	78.2	81.0	79.5	89.4	79	78.5
Mode	88	100, 74	92	85, 79	97	100	94, 67	84
Standard Deviation	10.2	12.29	12.87	11.24	12.61	12.58	11.61	13.4176
Scale for Test	none	$y = 6x + 40$	$y = 75x + 25$	$y = .545x + 45$	$y = .79x + 21$	none	$y = .638x + 36.2$	none

y = scaled score
x = raw score

SCIENCE FOR THE SPACE AGE I
1959-1960
TEST DATA

Grade	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Final
A	7.3%	9.5%	5.4%	3.1%	7.7%	6.6%	3.0%	11.0%
B	57.1	49.5	38.9	31.3	28.9	15.8	31.0	34.6
C	28.3	32.8	50.2	52.6	43.3	27.3	51.8	50.8
D	5.2	7.1	4.4	8.3	12.4	35.5	8.1	3.1
E	2.1	1.0	1.1	3.6	6.2	12.6	6.1	.5
F	—	—	—	1.1	1.5	2.2	—	—
Mean	28.1300	32.0964	28.7259	31.4082	17.6042	35.3128	22.8021	59.2199
Median	27.7000	32.750	27.6	31.30	16.61	31.07	22.32	58.25
Mode	26.	33.0000	25.0	30.	16.	25.	22.50	60.
Standard Deviation	7.74	7.7239	6.9304	7.7571	8.7089	17.5333	5.3554	16.6046

SCIENCE FOR THE SPACE AGE II
1960-1961
TEST DATA

Grade	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Test VIII	Final
A	17.0%	11.8%	9.7%	11.9%	14.9%	15.4%	17.5%	12.3%	16.9%
B	20.5	44.8	23.6	23.9	28.4	33.8	23.8	24.7	36.9
C	30.7	38.2	50.0	41.8	34.3	32.3	33.4	40.1	30.8
D	12.5	2.6	11.1	6.0	11.9	12.3	9.5	10.6	7.7
E	11.4	1.3	2.8	10.4	4.5	3.1	7.9	8.8	4.6
F	7.9	1.3	2.8	6.0	6.0	3.1	7.9	3.5	3.1
Mean	20.1	22.5616	16.5469	28.7671	19.6805	20.0694	27.000	26.79	60.5388
Median	19.5	22.64	16.26	28.9	20.06	19.29	26.25	25.45	60.43
Mode	15.0	24.	16.0	25.5	16.5, 20.5	12.0	19.28	19	49.
Standard Deviation	7.28	4.6523	6.4829	4.8058	5.3942	7.8324	8.9080	7.26	18.4851

APPENDIX B

Course Attitude Questionnaire
Frequency Distributions and Percentages

	Fall 1960						Spring 1961					
	Math		Sci		All		Math		Sci		All	
	f.	%	f.	%	f.	%	f.	%	f.	%	f.	%
I-1. Compared with other courses I am taking this year, the TV course is:												
probably the best one I have	25	14.8	4	7.1	29	12.9	19	11.2	8	14.3	27	12.0
one of the better courses, I suppose	64	37.9	17	30.4	81	36.0	40	23.7	8	14.3	48	21.4
about equal in value to my other courses	47	27.8	18	32.1	65	28.9	54	32.0	16	28.6	70	31.1
not quite as good as other courses I am taking	26	15.4	10	17.9	36	16.0	46	27.2	16	28.6	62	27.6
one of the poorest courses I am taking	7	4.1	7	12.5	14	6.2	10	5.9	8	14.3	18	8.0
I-2. If I had a schedule of elective courses and had to drop one of them, I would:												
probably drop the televised course last	24	14.2	8	14.3	32	14.3	13	7.7	3	5.4	16	7.1
be inclined to keep this course if I could	65	38.5	17	30.4	82	36.4	60	35.5	17	30.4	77	34.2
find it difficult to choose between dropping the TV course and another regular course	19	11.2	11	19.6	30	13.4	25	14.8	9	16.1	34	15.2
probably drop this course rather than a regular course	42	24.9	11	19.6	53	23.6	44	26.0	12	21.4	56	24.9
drop this course first	19	11.2	9	16.1	28	12.5	27	16.0	15	26.8	42	18.7

Course Attitude — Frequency Distributions and Percentages	Fall 1960						Spring 1961					
	Math		Sci		All		Math		Sci		All	
	f.	%	f.	%	f.	%	f.	%	f.	%	f.	%
I-3. Do you think the course is more or less interesting than regular school courses?												
much more interesting	41	24.3	14	25.0	55	24.5	19	11.2	10	17.9	29	12.9
a little more interesting	49	29.0	18	32.1	67	29.8	33	19.5	17	30.4	50	22.2
about the same	44	26.0	8	14.3	52	23.1	51	30.2	4	7.1	55	24.5
a little less interesting	20	11.8	8	14.3	28	12.5	46	27.2	16	28.6	62	27.6
much less interesting	15	8.9	8	14.3	23	10.2	20	11.8	9	16.1	29	12.9
I-4. I would advise my friends to take this course												
as one of the best courses they could possibly take	20	11.8	7	12.5	27	12.0	8	4.7	3	5.4	11	4.9
as a better choice than many others they might make	64	37.9	16	28.6	80	35.5	64	37.9	14	25.0	78	34.7
as a choice equal in value to most courses	44	26.0	16	28.6	60	26.7	41	24.3	13	23.2	54	24.0
only with some reservations	35	20.7	11	19.6	46	20.5	45	26.6	18	32.1	63	28.0
only if there were no way to avoid it	6	3.6	6	10.7	12	5.3	11	6.5	8	14.3	19	8.5
I-5. If you could have the same course taught by the same instructor taught in either a conventional classroom or on TV, which would you choose?												
the conventional classroom	126	74.6	44	78.6	170	75.5	139	82.2	48	85.7	187	83.1
TV	43	25.4	12	21.4	55	24.5	30	17.7	8	14.3	38	16.9
I-6. Is the information you are getting in this course more useful than in other courses?												
much more useful than average	19	11.2	8	14.3	27	12.0	18	10.6	9	16.1	27	12.0
a little more useful than average	38	22.5	19	33.9	57	25.4	40	23.7	14	25.0	54	24.0
about average	74	43.8	18	32.1	92	40.9	63	37.3	20	35.7	83	36.9
a little less useful than average	26	15.4	5	8.9	31	13.8	30	17.7	8	14.3	38	16.9
much less useful than average	12	7.1	6	10.7	18	8.0	18	10.6	5	8.9	23	10.2
I-7. How many things have you seen on TV which seldom can be seen in your regular math and science classes?												
much less	8	4.7	3	5.4	11	4.9	7	4.1	3	5.4	10	4.4
a little less	19	11.2	2	3.6	21	9.3	13	7.7	3	5.4	16	7.1
about the same	43	25.4	14	25.0	57	25.4	43	25.4	8	14.3	51	22.7
a little more	56	33.1	23	41.1	79	35.1	53	31.4	23	41.1	76	33.8
much more	43	25.4	14	25.0	57	25.4	53	31.4	19	33.9	72	32.0
I-8. If this TV course were to be continued next year with more advanced content, would you:												
enroll only as a last resort?	11	6.5	8	14.3	19	8.5	17	10.0	9	16.1	26	11.6
enroll only if no other similar courses were available?	12	7.1	2	3.6	14	6.2	15	8.9	4	7.1	19	8.5
be undecided about enrollment?	41	24.3	12	21.4	53	23.6	36	21.3	14	25.0	50	22.2
enroll if it were convenient?	58	34.3	18	32.1	76	33.8	67	39.7	15	26.8	82	36.4
want very much to enroll?	47	27.8	16	28.6	63	28.0	34	20.1	14	25.0	48	21.4
II-1. What is your opinion of the difficulty of the subject matter in the television course?												
much more difficult than regular school subjects	28	16.6	15	26.8	43	19.1	28	16.6	10	17.9	38	16.9
a little more difficult	61	36.1	21	37.5	82	36.4	70	41.4	29	51.8	99	44.0
about the same degree of difficulty	51	30.2	17	30.4	68	30.3	43	25.4	12	21.4	55	24.5
a little easier	15	8.9	2	3.6	17	7.6	18	10.6	4	7.1	22	9.8
much easier	14	8.3	1	1.8	15	6.7	10	5.9	1	1.8	11	4.9

Course Attitude — Frequency Distributions and Percentages

	Fall 1960						Spring 1961					
	Math		Sci		All		Math		Sci		All	
	f.	%	f.	%	f.	%	f.	%	f.	%	f.	%
II-2. The mimeographed achievement tests so far have been:												
rather rough	32	18.9	9	16.1	41	18.2	23	13.6	10	17.9	33	14.7
somewhat hard	50	29.6	25	44.6	75	33.3	60	35.5	24	42.9	84	37.3
no more difficult than in regular courses	42	24.9	14	25.0	56	24.9	52	30.8	19	33.9	71	31.5
as easy as could be expected	31	18.3	5	8.9	36	16.0	26	15.4	2	3.6	28	12.5
very easy	14	8.3	3	5.4	17	7.6	8	4.7	1	1.8	9	4.0
II-3. Do you think you are learning as much in the TV course as you learn in regular science or math courses?												
much less	14	8.3	10	17.9	24	10.7	33	19.5	11	19.6	44	19.6
a little less	32	18.9	9	16.1	41	18.2	41	24.3	15	26.8	56	24.9
about the same	65	38.5	16	28.6	81	36.0	47	27.8	15	26.8	62	27.6
a little more	38	22.5	14	25.0	52	23.1	28	16.6	9	16.1	37	16.5
much more	20	11.8	7	12.5	27	12.0	20	11.8	6	10.7	26	11.6
II-4. What is your opinion of the pace of the television course?												
much slower	8	4.7	5	8.9	13	5.8	12	7.1	6	10.7	18	8.0
a little slower	25	14.8	8	14.3	33	14.7	24	14.2	7	12.5	31	13.8
about the same	57	33.7	16	28.6	73	32.4	49	29.0	15	26.8	64	28.5
a little more rapid	53	31.4	19	33.9	72	32.0	51	30.2	16	28.6	67	29.8
much more rapid than regular school subjects	26	15.4	8	14.3	34	15.2	33	19.5	12	21.4	45	20.0
II-5. I find during the TV class that:												
there does not seem to be anything to warrant real mental effort	18	10.6	10	17.9	28	12.5	19	11.2	12	21.4	31	13.8
I get the material but it doesn't seem to need much thought	31	18.3	14	25.0	45	20.0	40	23.7	13	23.2	53	23.6
I do a fair amount of thinking about the lesson content	84	49.7	22	39.3	106	47.1	91	53.8	26	46.4	117	52.0
I do a great deal of thinking about what the instructor is saying	29	17.2	8	14.3	37	16.5	12	7.1	5	8.9	17	7.6
I am continually absorbed in thinking over what the instructor is saying	7	4.1	2	3.6	9	4.0	7	4.1	0	0	7	3.1
II-6. I could get excellent grades in the course:												
with very little effort	14	8.3	3	5.4	17	7.6	9	5.3	3	5.4	12	5.3
without too much work	23	13.6	9	16.1	32	14.3	24	14.2	10	17.9	34	15.2
with a reasonable amount of work	69	40.8	21	37.5	90	40.0	63	37.3	22	39.3	85	37.8
if I put some extra work into it	40	23.7	14	25.0	54	24.0	58	34.3	14	25.0	72	32.0
with a great deal of extra study	23	13.6	9	16.1	32	14.3	15	8.9	7	12.5	22	9.8
II-7. Are there times when the TV teacher presents material that you cannot understand clearly at the moment?												
most of the time	7	4.1	6	10.7	13	5.8	6	3.6	3	5.4	9	4.0
frequently	53	31.4	8	14.3	61	27.1	51	30.2	12	21.4	63	28.0
occasionally	80	47.3	33	58.9	113	50.2	92	54.4	32	57.1	124	55.1
rarely	25	14.8	8	14.3	33	14.7	19	11.2	8	14.3	27	12.0
never	4	2.4	1	1.8	5	2.2	1	0.6	1	1.8	2	0.9
III-1. How does your attention to the TV course compare with your attention in a regular class?												
much less attention than average	34	20.1	11	19.6	45	20.0	62	36.7	22	39.3	84	37.3
a little poorer attention than average	36	21.3	11	19.6	47	20.9	50	29.6	15	26.8	65	28.9
about the same	52	30.8	21	37.5	73	32.4	34	20.1	14	25.0	48	21.4
a little better attention than average	33	19.5	7	12.5	40	17.8	18	10.6	3	5.4	21	9.3
much better attention than average	14	8.3	6	10.7	20	8.9	5	3.0	2	3.6	7	3.1

Course Attitude — Frequency Distributions and Percentages

	Fall 1960						Spring 1961					
	Math		Sci		All		Math		Sci		All	
	f.	%	f.	%	f.	%	f.	%	f.	%	f.	%
III-2. Does your mind wander from the subject during television lessons?												
much less	16	9.5	7	12.5	23	10.2	12	7.1	3	5.4	15	6.7
a little less	29	17.2	5	8.9	34	15.2	15	8.9	5	8.9	20	8.9
about the same	50	29.6	19	33.9	69	30.7	36	21.3	14	25.0	50	22.2
a little more	37	21.9	14	25.0	51	22.7	48	28.4	13	23.2	61	27.1
much more than in a regular classroom	37	21.9	11	19.6	48	21.4	58	34.3	21	37.5	79	35.1
III-3. In the television class:												
time always passes very quickly	40	23.7	9	16.1	49	21.8	33	19.5	10	17.9	43	19.1
time usually passes very quickly	61	36.1	21	37.5	82	36.4	50	29.6	23	41.1	73	32.4
time sometimes passes very quickly	41	24.3	13	23.2	54	24.0	40	23.7	16	28.6	56	24.9
time usually seems to drag a bit	21	12.4	11	19.6	32	14.3	32	18.9	5	8.9	37	16.5
it seems as if the end of the period will never come	6	3.6	2	3.6	8	3.6	14	8.3	2	3.6	16	7.1
IV-1. How often did you jot down questions that occurred to you during the TV program to be asked of the visiting or seminar teachers?												
very frequently	7	4.1	1	1.8	8	3.6	2	1.2	0	0	2	0.9
frequently	12	7.1	7	12.5	19	8.5	8	4.7	2	3.6	10	4.4
sometimes	34	20.1	15	26.8	49	21.8	30	17.7	19	33.9	49	21.8
infrequently	39	23.1	19	33.9	58	25.8	50	29.6	19	33.9	69	30.7
never	77	45.5	14	25.0	91	40.4	79	46.7	16	28.6	95	42.2
IV-2. How well prepared (reading textbook assignments, studying notes, etc.) do you feel you were for the television course unit tests?												
much better prepared than for tests in regular courses	6	3.6	3	5.4	9	4.0	6	3.6	0	0	6	2.7
better prepared	22	13.0	4	7.1	26	11.6	13	7.7	2	3.6	15	6.7
about as well prepared	68	40.3	20	35.7	88	39.1	53	31.4	18	32.1	71	31.5
a little less prepared	47	27.8	14	25.0	61	27.1	62	36.7	13	23.2	75	33.3
much less prepared	26	15.4	15	26.8	41	18.2	35	20.7	23	41.1	58	25.8
IV-3. How much of the television course required reading do you do?												
very little	73	43.2	21	37.5	94	41.8	82	48.5	29	51.8	111	49.3
about one-quarter	16	9.5	4	7.1	20	8.9	17	10.0	9	16.1	26	11.6
about half	30	17.7	8	14.3	38	16.9	30	17.7	8	14.3	38	16.9
about three-quarters	22	13.0	9	16.1	31	13.8	19	11.2	6	10.7	25	11.1
all, or about all	28	16.6	14	25.0	42	18.7	21	12.4	4	7.1	25	11.1
V-1. How much reading and study outside of class did you do this year in the area of the subject taught on television?												
much more than I would have in a regular class	8	4.7	4	7.1	12	5.3	2	1.2	5	8.9	7	3.1
more	15	8.9	11	19.6	26	11.6	7	4.1	8	14.3	15	6.7
about the same amount	52	30.8	18	32.1	70	31.1	32	18.9	18	32.1	50	22.2
less	58	34.3	12	21.4	70	31.1	72	42.6	14	25.0	86	38.2
much less	36	21.3	11	19.6	47	20.9	56	33.1	11	19.6	67	29.8
V-2. To what extent are you able to find answers to questions you would otherwise ask your instructor in the basic text, in supplementary textbooks, or in other reading material?												
never	14	8.3	6	10.7	20	8.9	14	8.3	6	10.7	20	8.9
only with difficulty	36	21.3	5	8.9	41	18.2	28	16.6	7	12.5	35	15.6
part of the time	44	26.0	22	39.3	66	29.4	39	23.1	19	33.9	58	25.8
most of the time	64	37.9	20	35.7	84	37.3	73	43.2	20	35.7	93	41.3
easily and usually	11	6.5	3	5.4	14	6.2	15	8.9	4	7.1	19	8.5

Course Attitude — Frequency Distributions and Percentages	Fall 1960						Spring 1961					
	Math		Sci		All		Math		Sci		All	
	f.	%	f.	%	f.	%	f.	%	f.	%	f.	%
V-3. Do you feel like doing more outside reading in science or math as a result of having taken the TV course?												
much less than a year ago	12	7.1	1	1.8	13	5.8	14	8.3	3	5.4	17	7.6
a little less than a year ago	11	6.5	3	5.4	14	6.2	9	5.3	2	3.6	11	4.9
about the same	85	50.3	29	51.8	114	50.6	84	49.7	26	46.4	110	48.8
a little more than a year ago	46	27.2	17	30.4	63	28.0	47	27.8	14	25.0	61	27.1
much more than a year ago	15	8.9	6	10.7	21	9.3	15	8.9	11	19.6	26	11.6
V-4. I find myself thinking about the material in the TV course:												
a great deal	8	4.7	3	5.4	11	4.9	4	2.4	2	3.6	6	2.7
quite often	52	30.8	20	35.7	72	32.0	36	21.3	17	30.4	53	23.6
occasionally	75	44.4	22	39.3	97	43.1	77	45.5	22	39.3	99	44.0
little	14	8.3	6	10.7	20	8.9	24	14.2	7	12.5	31	13.8
hardly at all	20	11.8	5	8.9	25	11.1	28	16.6	8	14.3	36	16.0
V-5. The material in this TV course:												
is more difficult to remember than the material in most other courses	25	14.8	9	16.1	34	15.2	20	11.8	7	12.5	27	12.0
is more difficult to remember than the material in many other courses	46	27.2	14	25.0	60	26.7	47	27.8	18	32.1	65	28.9
is about as easy to remember as the material in most courses	76	45.0	27	48.2	103	45.7	80	47.3	25	44.6	105	46.7
is easier to remember than the material in many other courses	12	7.1	2	3.6	14	6.2	12	7.1	1	1.8	13	5.8
can be remembered with little difficulty	10	5.9	4	7.1	14	6.2	10	5.9	5	8.9	15	6.7
V-6. Do you feel that the television course stimulated your interest in mathematics or science beyond what would have been achieved in regular classes?												
much more	31	18.3	12	21.4	43	19.1	27	16.0	10	17.9	37	16.5
a little more	59	34.9	17	30.4	76	33.8	58	34.3	19	33.9	77	34.2
about the same	54	32.0	15	26.8	69	30.7	55	32.6	11	19.6	66	29.4
a little less	14	8.3	6	10.7	20	8.9	11	6.5	9	16.1	20	8.9
much less	11	6.5	6	10.7	17	7.6	18	10.6	7	12.5	25	11.1
V-7. Since my experience with the TV course:												
I want to major in this area	32	18.9	12	21.4	44	19.6	31	18.3	10	17.9	41	18.2
I almost think I might want to major in this area	28	16.6	5	8.9	33	14.7	21	12.4	12	21.4	33	14.7
I want to take more courses in this area but not major	54	32.0	24	42.9	78	34.7	53	31.4	15	26.8	68	30.3
I am not enthusiastic about taking more	39	23.1	10	17.9	49	21.8	51	30.2	13	23.2	64	28.5
I wouldn't take any more of this subject than I had to take	13	9.5	5	8.9	21	9.3	13	7.7	6	10.7	19	8.5
V-8. To what extent is the material learned in the TV course useful in English classwork?												
not at all	105	62.2	41	73.2	146	64.9	93	55.0	35	62.5	128	56.8
little	47	27.8	10	17.9	57	25.4	51	30.2	14	25.0	65	28.9
to some extent	17	10.0	4	7.1	21	9.3	24	14.2	6	10.7	30	13.4
to a great extent	0	0	1	1.8	1	0.4	1	0.6	1	1.8	2	0.9
V-9. To what extent is the material learned in the TV course useful in other mathematics courses?												
not at all	11	6.5	10	17.9	21	9.3	8	4.7	7	12.5	15	6.7
little	33	19.5	14	25.0	47	20.9	20	11.8	14	25.0	34	15.2
to some extent	85	50.3	27	48.2	112	49.8	90	53.2	31	55.4	121	53.7
to a great extent	40	23.7	5	8.9	45	20.0	51	30.2	4	7.1	55	24.5

3

Course Attitude — Frequency Distributions and Percentages

	Fall 1960						Spring 1961					
	Math		Sci		All		Math		Sci		All	
	f.	%	f.	%	f.	%	f.	%	f.	%	f.	%
V-10. To what extent is the material learned in the TV course useful in other science courses?												
not at all	44	26.0	10	17.9	54	24.0	39	23.1	8	14.3	47	20.9
little	56	33.1	8	14.3	64	28.5	52	30.8	9	16.1	61	27.1
to some extent	59	34.9	24	42.9	83	36.9	69	40.8	25	44.6	94	41.8
to a great extent	10	5.9	14	25.0	24	10.7	9	5.3	14	25.0	23	10.2
V-11. To what extent is the material learned in the TV course useful in classwork in history courses?												
not at all	129	76.3	43	76.8	172	76.5	123	72.8	36	64.3	159	70.6
little	35	20.7	9	16.1	44	19.6	38	22.5	14	25.0	52	23.1
to some extent	5	3.0	4	7.1	9	4.0	8	4.7	6	10.7	14	6.2
to a great extent	0	0	0	0	0	0	0	0	0	0	0	0
VI-1. How many times have you attended the television class?												
fewer than 50% of the classes	3	1.8	1	1.8	4	1.8	4	2.4	1	1.8	5	2.2
at least 50% of the classes	2	1.2	0	0	2	0.9	1	0.6	0	0	1	0.4
at least 80% of the classes	71	42.0	26	46.4	97	43.1	94	55.6	37	66.1	131	58.2
all classes except when I was absent from school	64	37.9	21	37.5	85	37.8	60	35.5	16	28.6	76	33.8
every class so far	29	17.2	8	14.3	37	16.5	10	5.9	2	3.6	12	5.3
VI-2. If you did not attend TV classes on days when you were in school, the reason was:												
(No response)	87	51.5	25	44.6	112	49.8	66	39.1	14	25.0	80	35.5
conflict with other classes which came during the same period	21	12.4	8	14.3	29	12.9	24	14.2	9	16.1	33	14.7
the rotating schedule of the school	7	4.1	7	12.5	14	6.2	6	3.6	8	14.3	14	6.2
other — please indicate	54	32.0	16	28.6	20	31.1	73	43.2	25	44.6	98	43.6
VI-3. Were your television classes supervised by teachers while the courses were being televised?												
not at all	38	22.5	27	48.2	65	28.9	40	23.7	30	53.6	70	31.1
infrequently	28	16.6	10	17.9	38	16.9	28	16.6	8	14.3	36	16.0
some of the time	15	8.9	5	8.9	20	8.9	13	7.7	4	7.1	17	7.6
most of the time	26	15.4	4	7.1	30	13.4	28	16.6	5	8.9	33	14.7
all of the time	62	36.7	10	17.9	72	32.0	60	35.5	9	16.1	69	30.7
VI-4. How do you feel about not being able to get immediate answers to questions you have while viewing the TV program?												
it doesn't bother me at all	16	9.5	9	16.1	25	11.1	18	10.6	8	14.3	26	11.6
it doesn't bother me very much	30	17.7	12	21.4	42	18.7	20	11.8	12	21.4	32	14.3
it bothers me at times	45	26.6	16	28.6	61	27.1	51	30.2	16	28.6	67	29.8
it is a minor disadvantage	31	18.3	9	16.1	40	17.8	36	21.3	12	21.4	48	21.4
it is a very serious disadvantage	47	27.8	10	17.9	57	25.4	44	26.0	8	14.3	52	23.1

APPENDIX C

Course Attitude Questionnaire

Analysis of Responses from Mathematics II

TEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
-1	1	25	19	6	36	1.440	4
	2	64	40	24	576	9.000	
	3	47	54	7	49	1.043	Negative
	4	26	46	20	400	15.385	at 1% level
	5	7	10	3	9	1.286	
						28.154	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
I-2	1	24	13	11	121	5.042	4
	2	65	60	5	25	0.385	
	3	19	25	6	36	1.895	Negative
	4	42	44	2	4	0.095	at 5% level
	5	19	27	8	64	3.368	
						10.785	
I-3	1	41	19	22	484	11.805	4
	2	49	33	16	256	5.224	
	3	44	51	7	49	1.114	Negative
	4	20	46	26	676	33.800	at 1% level
	5	15	20	5	25	1.667	
						53.610	
I-4	1	20	8	12	144	7.200	4
	2	64	64	0	0	—	
	3	44	41	3	9	0.205	Negative
	4	35	45	10	100	2.857	at 1% level
	5	6	11	5	25	4.167	
						14.429	
I-5	1	126	139	13	169	1.341	1
	2	43	30	13	169	3.930	Negative
							at 5% level
						5.271	
I-6	1	19	18	1	1	0.053	4
	2	38	40	2	4	0.105	
	3	74	63	11	121	1.635	at 30% level
	4	26	30	4	16	0.615	
	5	12	18	6	36	3.000	
						5.408	
I-7	1	8	7	1	1	0.125	4
	2	19	13	6	36	1.895	
	3	43	43	0	0	—	at 50% level
	4	56	53	3	9	0.161	
	5	43	53	10	100	2.326	
						4.507	
I-8	1	11	17	6	36	3.273	4
	2	12	15	3	9	0.750	
	3	41	36	5	25	0.610	Negative
	4	58	67	9	81	1.397	at 5% level
	5	47	34	13	169	3.596	
						9.626	
II-1	1	28	28	0	0	—	4
	2	61	70	9	81	1.328	
	3	51	43	8	64	1.255	at 50% level
	4	15	18	3	9	0.600	
	5	14	10	4	16	1.143	
						4.326	
II-2	1	32	23	9	81	2.531	4
	2	50	60	10	100	2.000	
	3	42	52	10	100	2.381	Positive
	4	31	26	5	25	0.806	at 5% level
	5	14	8	6	36	2.571	
						10.289	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
II-3	1	14	33	19	361	25.786	4
	2	32	41	9	81	2.531	
	3	65	47	18	324	4.985	Negative
	4	38	28	10	100	2.632	at 1% level
	5	20	20	0	0	—	
						35.934	
II-4	1	8	12	4	16	2.000	4
	2	25	24	1	1	0.040	
	3	57	49	8	64	1.123	at 30% level
	4	53	51	2	4	0.075	
	5	26	33	7	49	1.885	
						5.123	
II-5	1	18	19	1	1	0.056	4
	2	31	40	9	81	2.613	
	3	84	91	7	49	0.583	Negative
	4	29	12	17	289	9.966	at 5% level
	5	7	7	0	0	—	
						13.218	
II-6	1	14	9	5	25	1.786	4
	2	[illegible]	24	1	1	0.043	
	3	69	63	6	36	0.522	Positive
	4	40	58	18	324	8.100	at 5% level
	5	23	15	8	64	2.783	
						[illegible].234	
II-7	1	7	6	1	1	0.143	3
	2	53	51	2	4	0.075	
	3	80	92	12	144	1.800	at 20% level
	4 & 5	29	20	9	81	2.793	
						4.811	
III-1	1	34	62	28	784	23.059	4
	2	36	50	14	196	5.444	
	3	52	34	18	324	6.231	Negative
	4	33	18	15	225	6.818	at 1% level
	5	14	5	9	81	5.786	
						47.338	
III-2	1	16	12	4	16	1.000	4
	2	29	15	14	196	6.759	
	3	50	36	14	196	3.920	Negative
	4	37	48	11	121	3.270	at 1% level
	5	37	58	21	441	11.919	
						26.868	
III-3	1	40	33	7	49	1.225	4
	2	61	50	11	121	1.984	
	3	41	40	1	1	0.024	Negative
	4	21	32	11	121	5.762	at 1% level
	5	6	14	8	64	10.667	
						19.662	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
IV-1	1	7	2	5	25	3.571	4
	2	12	8	4	16	1.250	
	3	34	30	4	16	0.471	at 10% level
	4	39	50	11	121	3.123	
	5	77	79	2	4	0.052	
						8.467	
IV-2	1	6	6	0	0	—	4
	2	22	13	9	81	3.682	
	3	68	53	15	225	3.309	Negative
	4	47	62	15	225	4.787	at 1% level
	5	26	35	9	81	3.115	
						14.893	
IV-3	1	73	82	9	81	1.110	4
	2	16	17	1	1	0.062	
	3	30	30	0	0	—	Below 50% level
	4	22	19	3	9	0.409	
	5	28	21	7	49	1.750	
						3.331	
V-1	1	8	2	6	36	4.500	4
	2	15	7	8	64	4.267	
	3	52	32	20	400	7.692	Negative
	4	58	72	14	196	3.379	at 1% level
	5	36	56	20	400	11.111	
						30.949	
V-2	1	14	14	0	0	—	4
	2	36	28	8	64	1.778	
	3	44	39	5	25	0.568	at 30% level
	4	64	73	9	81	1.266	
	5	11	15	4	16	1.455	
						5.067	
V-3	1	12	14	2	4	0.333	4
	2	11	9	2	4	0.364	
	3	85	84	1	1	0.012	Below 50% level
	4	46	47	1	1	0.022	
	5	15	15	0	0	—	
						0.731	
V-4	1	8	4	4	16	2.000	4
	2	52	36	16	256	4.923	
	3	75	77	2	4	0.053	Negative
	4	14	24	10	100	7.143	at 1% level
	5	20	28	8	64	3.200	
						17.319	
V-5	1	25	20	5	25	1.000	4
	2	46	47	1	1	0.022	
	3	76	80	4	16	0.211	Below 50% level
	4	12	12	0	0	—	
	5	10	10	0	0	—	
						1.233	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
V-6	1	31	27	4	16	0.516	4
	2	59	58	1	1	0.017	
	3	54	55	1	1	0.019	at 30% level
	4	14	11	3	9	0.643	
	5	11	18	7	49	4.455	
						5.650	
V-7	1	32	31	1	1	0.031	4
	2	28	21	7	49	1.750	
	3	54	53	1	1	0.019	at 20% level
	4	39	51	12	144	3.692	
	5	16	13	3	9	0.562	
						6.054	
V-8	1	105	93	12	144	1.371	2
	2	47	51	4	16	0.340	
	3 & 4	17	25	8	64	3.765	at 10% level
						5.476	
V-9	1	11	8	3	9	0.818	3
	2	33	20	13	169	5.121	
	3	85	90	5	25	0.294	Positive
	4	40	51	11	121	3.025	at 5% level
						9.258	
V-10	1	44	39	5	25	0.568	3
	2	56	52	4	16	0.286	
	3	59	69	10	100	1.695	at 50% level
	4	10	9	1	1	0.100	
						2.649	
V-11	1	129	123	6	36	0.279	2
	2	35	38	3	9	0.255	
	3 & 4	5	8	3	9	1.800	at 50% level
						2.334	
VI-1	1 & [illegible]	5	5	0	0	—	3
	3	71	94	13	169	2.380	
	4	64	60	4	16	0.250	Negative
	5	29	10	19	361	12.448	at 1% level
						15.078	
VI-2	0	87	66	21	441	5.069	3
	1	21	24	3	9	0.429	
	2	7	6	1	1	0.143	Negative
	3	54	73	19	361	6.685	at 1% level
						12.326	
VI-3	1	38	40	2	4	0.105	4
	2	28	28	0	0	—	
	3	15	13	2	4	0.267	Below 50% level
	4	26	28	2	4	0.154	
	5	62	60	2	4	0.065	
						0.591	
VI-4	1	16	18	2	4	0.250	4
	2	30	20	10	100	3.333	
	3	45	51	6	36	0.800	at 30% level
	4	31	36	5	25	0.806	
	5	47	44	3	9	0.191	
						5.380	

Course Attitude Questionnaire
Analysis of Responses from Science II

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
I-1	1 & 2	21	16	5	25	1.190	3
	3	18	16	2	4	0.222	
	4	10	16	6	36	3.600	at 20% level
	5	7	8	1	1	0.143	
						5.155	
I-2	1	8	3	5	25	3.125	4
	2	17	17	0	—	—	
	3	11	9	2	4	0.364	at 20% level
	4	11	12	1	1	0.091	
	5	9	15	6	36	4.000	
						7.580	
I-3	1	14	10	4	16	1.143	4
	2	18	17	1	1	0.056	
	3	8	4	4	16	2.000	Negative
	4	8	16	8	64	8.000	at 5% level
	5	8	9	1	1	0.125	
						11.324	
I-4	1	7	3	4	16	2.286	4
	2	16	14	2	4	0.250	
	3	16	13	3	9	0.562	at 10% level
	4	11	18	7	49	4.455	
	5	6	8	2	4	0.667	
						8.220	
I-5	1	44	48	4	16	0.364	1
	2	12	8	4	16	1.333	at 20% level
						1.697	
I-6	1	8	9	1	1	0.125	4
	2	19	14	5	25	1.316	
	3	18	20	2	4	0.222	at 50% level
	4	5	8	3	9	1.800	
	5	6	5	1	1	0.167	
						3.630	
I-7	1 & 2	5	6	1	1	0.200	3
	3	14	8	4	16	1.143	
	4	23	23	0	—	—	at 50% level
	5	14	19	5	25	1.786	
						3.129	
I-8	1 & 2	10	13	3	9	0.900	3
	3	12	14	2	4	0.333	
	4	18	15	3	9	0.500	Below 50% level
	5	16	14	2	4	0.250	
						1.983	
II-1	1	15	10	5	25	1.667	2
	2	21	29	8	64	3.048	
	3, 4 & 5	20	17	3	9	0.450	at 10% level
						5.165	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
II-2	1	9	10	1	1	0.111	3
	2	25	24	1	1	0.040	
	3	14	19	5	25	1.786	at 20% level
	4 & 5	8	3	5	25	3.125	
						5.062	
II-3	1	10	11	1	1	0.100	4
	2	9	15	6	36	4.000	
	3	16	15	1	1	0.062	at 20% level
	4	14	9	5	25	1.786	
	5	7	6	1	1	0.143	
						6.091	
II-4	1	5	6	1	1	0.200	4
	2	8	7	1	1	0.125	
	3	16	15	1	1	0.062	Below 50% level
	4	19	16	3	9	0.474	
	5	8	12	4	16	2.000	
						2.861	
II-5	1	10	12	2	4	0.400	3
	2	14	13	1	1	0.071	
	3	22	26	4	16	0.727	at 30% level
	4 & 5	10	5	5	25	2.500	
						3.698	
II-6	1 & 2	12	13	1	1	0.083	3
	3	21	22	1	1	0.048	
	4	14	14	0	—	—	Below 50% level
	5	9	7	2	4	0.444	
						0.575	
II-7	1	6	3	3	9	1.500	3
	2	8	12	4	16	2.000	
	3	33	32	1	1	0.030	at 50% level
	4 & 5	9	9	0	—	—	
						3.530	
III-1	1	11	22	11	121	11.000	4
	2	11	15	4	16	1.455	
	3	21	14	7	49	2.333	Negative at 1% level
	4	7	3	4	16	2.286	
	5	6	2	4	16	2.667	
						19.741	
III-2	1	7	3	4	16	2.286	4
	2	5	5	0	—	—	
	3	19	14	5	25	1.316	Negative at 5% level
	4	14	13	1	1	0.071	
	5	11	21	10	100	9.091	
						12.764	
III-3	1	9	10	1	1	0.111	3
	2	21	23	2	4	0.190	
	3	13	16	3	9	0.692	at 30% level
	4 & 5	13	7	6	36	2.769	
						3.762	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
IV-1	1 & 2	8	2	6	36	2.769	3
	3	15	19	4	16	1.067	
	4	19	19	0	—	—	at 30% level
	5	14	16	2	4	0.286	
						4.122	
IV-2	1 & 2	7	2	5	25	3.571	3
	3	20	18	2	4	0.200	
	4	14	13	1	1	0.071	Negative at
	5	15	23	8	64	4.267	5% level
						8.109	
IV-3	1 & 2	25	38	13	169	6.760	3
	3	8	8	0	—	—	
	4	9	6	3	9	1.000	Negative at
	5	14	4	10	100	7.143	1% level
						14.903	
V-1	1 & 2	15	13	2	4	0.267	3
	3	18	18	0	—	—	
	4	12	14	2	4	0.333	Below 50% level
	5	11	11	0	—	—	
						0.600	
V-2	1	6	6	0	—	—	3
	2	5	7	2	4	0.800	
	3	22	19	3	9	0.409	Below 50% level
	4 & 5	23	24	1	1	0.043	
						1.252	
V-3	1 & 2	4	5	1	1	0.250	3
	3	29	26	3	9	0.310	
	4	17	14	3	9	0.529	at 20% level
	5	6	11	5	25	4.167	
						5.256	
V-4	1 & 2	23	19	4	16	0.696	3
	3	22	22	0	—	—	
	4	6	7	1	1	0.167	at 50% level
	5	5	8	3	9	1.800	
						2.663	
V-5	1	9	7	2	4	0.444	3
	2	14	18	4	16	1.143	
	3	27	25	2	4	0.148	Below 50% level
	4 & 5	6	6	0	—	—	
						1.735	
V-6	1	12	10	2	4	0.333	4
	2	17	19	2	4	0.235	
	3	15	11	4	16	1.067	Below 50% level
	4	6	9	3	9	1.500	
	5	6	7	1	1	0.167	
						3.302	

ITEM	RESPONSE	FALL EXPECTED	SPRING ACTUAL	DIFFERENCE	DIFFERENCE SQUARED	χ^2	d.f. SIGNIFICANCE
V-7	1	12	10	2	4	0.333	4
	2	5	12	7	49	9.800	
	3	24	15	9	81	3.375	Negative
	4	10	13	3	9	0.900	at 1% level
	5	5	6	1	1	0.200	
						14.608	
V-8	1	41	35	6	36	0.878	2
	2	10	14	4	16	1.600	
	3 & 4	5	7	2	4	0.800	at 20% level
						3.278	
V-9	1	10	7	3	9	0.900	3
	2	14	14	0	—	—	
	3	27	31	4	16	0.593	Below 50% level
	4	5	4	1	1	0.200	
						1.693	
V-10	1	10	8	2	4	0.400	3
	2	8	9	1	1	0.125	
	3	24	25	1	1	0.042	Below 50% level
	4	14	14	0	—	—	
						0.567	
V-11	1	43	36	7	49	1.140	2
	2	9	14	5	25	2.778	
	3 & 4	4	6	2	4	1.000	at 10% level
						4.918	
VI-1	1, 2, & 3	27	38	11	121	4.481	2
	4	21	16	5	25	1.190	Negative
	5	8	2	6	36	4.500	at 1% level
						10.171	
VI-2	0	25	14	11	121	4.840	3
	1	8	9	1	1	0.125	
	2	7	8	1	1	0.143	Negative
	3	16	25	9	81	5.062	at 5% level
						10.170	
VI-3	1	27	30	3	9	0.333	3
	2	10	8	2	4	0.400	
	3	5	4	1	1	0.200	Below 50% level
	4 & 5	14	14	0	—	—	
						0.933	
VI-4	1	9	8	1	1	0.111	4
	2	12	12	0	—	—	
	3	16	16	0	—	—	Below 50% level
	4	9	12	3	9	1.000	
	5	10	8	2	4	0.400	
						1.511	

APPENDIX D

Relationship between the Mean Scores on STEP Mathematics and Science and the Number of Related Courses Previously or Concurrently Taken

Before analyzing the data available, four hypotheses were formed:

1. The students with the least preparation in a subject will show the greatest gain between fall and spring in the related STEP.

2. The more preparation a student has had in a subject, the higher will be his score on the fall administration of the related STEP.

3. The more preparation in science a student has had, the better will be his understanding of " the role science plays in contemporary society " and " the way scientists as a group differ from people in general," as measured by Scales 1 and 2, respectively, of the FAS Test.

4. The gains between fall and spring in the STEP Mathematics by students not enrolled concurrently in a conventional mathematics course will not be significant because this test generally does not measure the subject matter presented in the televised mathematics course.

TABLE A

Mean Scores on Fall and Spring Administration of Related STEP

Number of Previous or Concurrent Courses in Subject Area of TV Course in Which Enrolled	Concepts of Mathematics I		Science for the Space Age I		Concepts of Mathematics II		Science for the Space Age II	
	Fall Scores	Spring Scores	Fall Scores	Spring Scores	Fall Scores	Spring Scores	Fall Scores	Spring Scores
No previous courses	293.3333	294.9565	288.7333	297.0666	287.2500	292.0000	281.4000	290.8000
Two previous courses	295.0000	295.0000	293.5000	299.0000	281.0000	277.7500	289.5000	292.4286
Two previous and one concurrent course	288.9444	292.3483	295.6024	302.8588	289.8718	296.6944	297.5151	298.2000
Three previous courses	296.1364	296.0000	292.5000	299.1000	290.4687	294.0333	288.4000	288.0000
Three previous and one concurrent course	298.5244	303.1646	298.9176	306.3427	296.9459	301.7736	303.2222	305.3333
Three previous courses, including a televised course, and one concurrent course					308.0000	312.0000	317.0000	306.0000
Four previous courses including a televised course					296.7692	298.6666	310.0000	310.0000
Four previous courses, including a televised course, and one concurrent course					304.0000	304.2500	303.2500	300.2500

TABLE B

Analysis of Mean Gain in STEP Science and FAS Test Scores by Previous and Concurrent Courses for Science for the Space Age I Students

Number of Previous or Concurrent Courses in Subject Area of TV Course in Which Enrolled	Number of Students	Test Date	Mean STEP Scores	Mean Gain	t-Test	Mean FAS 1 Scores	Mean Gain	t-Test	Mean FAS 2 Scores	Mean Gain	t-Test
No previous courses [1]/	30	Fall	288.7333	8.3333	2.5439*	26.5172 [2]/	1.3828	1.7285	25.4483 [2]/	2.5850	2.5612*
	30	Spring	297.0666			27.9000			28.0333		
Two previous courses	14	Fall	293.5000	5.5000	1.3843	27.0714	2.6915	2.0110*	25.0429	2.7857	2.0145*
	14	Spring	299.0000			29.6429			28.4286		
Two previous and one concurrent course	83	Fall	295.6024	7.2564	3.7561*	27.1071 [3]/	1.1047	1.8193	27.6667 [3]/	1.7569	2.5607*
	85	Spring	302.8588			28.2118			29.4235		
Three previous courses	10	Fall	292.5000	6.6000	.3667	28.0000	1.5000	.9186	28.0000	3.0000	1.9635*
	10	Spring	299.1000			29.5000			31.0000		
Three previous and one concurrent course	58	Fall	298.9176	7.4251	3.3601*	27.9483	.7466	1.2320	28.3966	1.2814	1.3742
	59	Spring	306.3427			28.6949			29.6780		
Total	195	Fall	296.0974	6.6248	5.6047*	27.3128	1.1619	3.2061*	27.4256	1.8723	4.1086*
	198	Spring	302.7222			28.4747			29.2979		

[1]/ Includes students with one previous course.

[2]/ Only 29 cases.

[3]/ 84 cases.

TABLE C

Analysis of Mean Gain in STEP Science and FAS Test Scores by Previous and Concurrent Courses for Science for the Space Age II Students

Number of Previous or Concurrent Courses in Subject Area of TV Course in Which Enrolled	Number of Students	Test Date	Mean STEP Scores	Mean Gain	t-Test	Mean FAS 1 Scores	Mean Gain	t-Test	Mean FAS 2 Scores	Mean Gain	t-Test
No previous courses [1]/	5	Fall	281.4000	9.4000	1.5889	24.8000	.4000	.1271	26.0000	.6000	.1416
	5	Spring	290.8000			25.2000			26.6000		
Two previous courses	8	Fall	289.5000	2.9286	.3707	26.1250	1.7321	.7219	27.7500	–.1786	–.0738
	7	Spring	292.4286			27.8571			27.5714		
Two previous and one concurrent course	33	Fall	297.5151	.6849	.2197	26.3636	.2916	.1909	26.7272	1.3728	.8608
	30	Spring	298.2000			26.6552 [2]/			28.1000 [2]/		
Three previous courses	5	Fall	288.4000	–.4000	–.0534	25.8000	–2.4662	–.5160	26.2000	1.1333	.2033
	5	Spring	288.0000			23.3333 [3]/			27.3333 [3]/		
Three previous and one concurrent course	9	Fall	303.2222	2.1111	.3920	28.4444	2.1111	1.6218	28.5555	1.1111	.5987
	9	Spring	305.3333			30.5555			29.6666		
Three previous courses, including a televised course, and one concurrent course	1	Fall	317.0000	–11.0000	—	32.0000	3.0000	—	31.0000	4.0000	—
	1	Spring	306.0000			35.0000			35.0000		
Four previous courses, including a televised course	6	Fall	310.0000	.0000	—	29.3333	–1.3333	–.5076	28.6667	.6666	.2582
	6	Spring	310.0000			28.0000			29.3333		
Four previous courses, including a televised course, and one concurrent course	4	Fall	303.2500	–3.000	–.3519	30.0000	–3.0000	–.7433	31.5000	–.7500	–.2455
	4	Spring	300.2500			27.0000			30.7500		
Total	71	Fall	297.2112	1.3261	.5086	26.9859	.3579	.4416	27.4789	1.0211	1.2220
	67	Spring	298.5373			27.3438 [4]/			28.5000 [4]/		

[1]/ Includes students with one previous course.

[2]/ Only 29 cases.

[3]/ Only 3 cases.

[4]/ Only 64 cases.

TABLE D

Analysis of Mean Gain in STEP Mathematics Scores by Previous and Concurrent Courses for Concepts of Mathematics Students

Number of Previous or Concurrent Courses in Subject Area of TV Course in Which Enrolled	Concepts of Mathematics I					Concepts of Mathematics II				
	Number of Students	Test Date	Mean STEP Scores	Mean Gain	t-Test	Number of Students	Test Date	Mean STEP Scores	Mean Gain	t-Test
No previous courses ¹/	21	Fall	293.3333	1.6232	.3943	4	Fall	287.2500	4.7500	.4965
	23	Spring	294.9565			5	Spring	292.0000		
Two previous courses	10	Fall	295.0000	0.2000	.0426	4	Fall	281.0000	–3.25	–.6284
	10	Spring	295.2000			4	Spring	277.7500		
Two previous and one concurrent course	89	Fall	288.9444	3.4039	1.3914	39	Fall	289.8718	6.8226	2.9851*
	88	Spring	292.3483			36	Spring	296.6944		
Three previous courses	22	Fall	296.1364	–.1364	–.0217	32	Fall	290.4687	3.5636	1.7163
	22	Spring	296.0000			31	Spring	294.0323		
Three previous and one concurrent course	82	Fall	298.5244	4.6402	1.2000	111	Fall	296.9459	4.8277	3.5331*
	79	Spring	303.1646			106	Spring	301.7736		
Three previous courses, including a televised course, and one concurrent course						2	Fall	308.0000	4.0000	1.2649
						2	Spring	312.0000		
Four previous courses, including a televised course						13	Fall	296.7692	1.8974	.3848
						12	Spring	298.6666		
Four previous courses, including a televised course, and one concurrent course						8	Fall	304.0000	.2500	.0600
						8	Spring	304.2500		
Total	224	Fall	295.1295	3.1453	1.7753	213	Fall	294.5540	4.4509	2.3647*
	222	Spring	298.2748			204	Spring	299.0049		

¹/ Includes students with one previous course.

Hypothesis 1. *The students with the least preparation in a subject will show the greatest gain between fall and spring in the related STEP.*

Tables B and C show that in both years the gain by the " no previous courses " group in the Science for the Space Age courses was numerically higher than that made by any other group (8.3333 in 1959-1960 and 9.4000 in 1960-1961). The difference in gain among groups was statistically significant the first year at the 1.1 per cent level. In 1960-1961 the difference in gain was not significant, partly because of the smaller numbers of pupils enrolled.

Table D indicates that in the televised mathematics courses the largest gain in mean score was made during the first year by the " two previous and one concurrent course " group. The differences were not statistically significant. However, during the second year, the " three previous and one concurrent course " group registered the highest gain and the " two previous and one concurrent course " group registered the second highest gain. Both of these groups had in the second year significantly larger gain than the gain by the " no previous courses " group.

It would appear that the hypothesis was invalid for the science students, but tended to be true for the mathematics pupils.

Hypothesis 2. *The more preparation a student has had in a subject, the higher will be his score on the fall administration of the related STEP.*

Examination of Tables A, B, C, and D show that generally this hypothesis is true, for with few exceptions the scores on the fall administration of the tests increase as the number of previous related courses becomes greater. Some of the few variations in trend may be due to the small numbers in some groups.

TABLE E

Gain between Fall and Spring in Mean Scores on FAS Test of Science for the Space Age Students without a Concurrent Science Course Compared to Gains by Students Enrolled in a Concurrent Science Course

			Science for the Space Age I			Science for the Space Age II		
Test	Group	Test Date	Mean Score	Mean Gain	t-Ratio	Mean Score	Mean Gain	t-Ratio
FAS Scale 1	Without a Concurrent Course	Fall	26.9434	1.7047	2.6495*	26.0000	.6250	.3682
		Spring	28.6481			26.6250		
	With a Concurrent Course	Fall	27.4507	.9590	2.2251*	27.3462	.2371	.2258
		Spring	28.4097			27.5833		
FAS Scale 2	Without a Concurrent Course	Fall	25.9811	2.7040	3.6629	27.0526	.6349	.3548
		Spring	28.6851			27.6875		
	With a Concurrent Course	Fall	27.5764	1.9513	3.1738	27.6346	1.1362	1.2794
		Spring	29.5277			28.7708		

Hypothesis 3. *The more preparation in science a student has had, the better will be his understanding of " the role science plays in contemporary society " and " the way scientists as a group differ from people in general," as measured by Scales 1 and 2, respectively, of the FAS test.*

Examination of Tables B and C shows that in the fall administration of both Scales of the Facts About Science Test, there is, with only minor breaks, an increase in fall scores which corresponds with an increase in the number of previous courses in science.

The spring test scores in 1960 indicate a change in attitude on both scales that is significant. This change may in part be due to the effect of the television course and in part to concurrent courses. In the second year there was no significant change in attitude.

In Table E, the students are divided into two groups, one consisting of those who had a concurrent science course and one without a concurrent course. In the first year the gains of both groups on both scales are significant. In the second year the gains were not significant.

TABLE F

Gains between Fall and Spring in Mean Scores on Related STEP of Students Without a Related Concurrent Course Compared to Gains by Students Enrolled in a Concurrent Related Course

Group	Test Date	Concepts of Mathematics I			Concepts of Mathematics II			Science for the Space Age I			Science for the Space Age II		
		Mean Score	Mean Gain	t-Ratio	Mean Score	Mean Gain	t-Ratio	Mean Score	Mean Gain	t-Ratio	Mean Score	Mean Gain	t-Ratio
Without a Concurrent Course	Fall	294.8113	.6068	.1982	290.0952	3.0000	1.3629	291.1666	5.8911	2.6001°	288.5263	2.9737	.6674
	Spring	295.4181			293.0952			297.9444			291.5000		
With a Concurrent Course	Fall	295.2281	3.9875	1.8924	295.6491	4.8879	2.1539°	297.9858	6.5280	4.4105°	300.3846	.7378	.2459
	Spring	299.2156			300.5370			304.5138			301.1624		

Hypothesis 4. *The gain between fall and spring in the STEP Mathematics by students not enrolled concurrently in a conventional mathematics course will not be significant because this test generally does not measure the subject matter presented in the televised mathematics course.*

Table F shows that in both years the mean gain of the group without a concurrent course on the STEP Mathematics was not significant. Larger gains were registered by the groups who had concurrent mathematics courses, with the gain in the second year a significant one.

APPENDIX E

Sex Differences Among Nine O'Clock Scholar Students

In an attempt to ascertain the effect of sex differences on participation and performance in the Nine O'Clock Scholar program several hypotheses were formulated and tested.

Hypothesis: *A higher proportion of girls took Science for the Space Age than Concepts of Mathematics.*

TABLE A

Course Distribution of Students by Sex

	Mathematics I		Science I		Mathematics II		Science II	
	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected
Boys	161	161	137	137	141	146.5	59	49.6
Girls	73	73	62	62	72	66.5	16	25.4
Totals	234	234	199	199	213	213.0	75	75.0
	$\chi^2 = 0$		$\chi^2 = 0$		$\chi^2 = .7187$		$\chi^2 = 5.2602$*	

In Table A only the distribution of students in Science for the Space Age II has a significant deviation from the expected distribution, and that is in the opposite direction from the hypothesis. These data indicate that the hypothesis is invalid.

Hypothesis: *A lower proportion of girls took the televised courses than the proportion of girls in 10th-, 11th-, and 12th-grade academic courses in Maine.*

TABLE B

Number of Girls Enrolled in the Televised Courses Compared with the Number Expected in Comparison with the Total Number of Girls in the Academic Course in Maine Schools

	Actual	Expected	χ^2
Concepts of Mathematics I	73	81.8	.9467
Science for the Space Age I	62	69.7	.8531
Concepts of Mathematics II	72	74.4	.0774
Science for the Space Age II	16	26.2	3.9710
			5.8482

Table B shows no significant deviation from the expected distribution of girls in the academic course in Maine. It shows the distribution of girls in the televised courses is what could be expected. Therefore this hypothesis is not valid.

Hypothesis: *Compared to the boys in the program, girls achieved higher scores on the SCAT Verbal Test but lower on SCAT Quantitative and FAS and about the same on the STEP Mathematics and Science Tests. Girls performed about the same or better on staff-prepared unit and final achievement tests.*

TABLE C

Differences between Boys and Girls in Mean Scores on Final SCAT Verbal, Final SCAT Quantitative, FAS I and II Tests, STEP Mathematics and STEP Science

	Course	Sex		SCAT Verbal	SCAT Quantitative	FAS Scale I	FAS Scale II	STEP Math	STEP Science
1959-1960	Mathematics	Boys (161) Girls (72)	Mean Scores	302.4342 304.5352	321.6974 318.8309	28.3576 27.6056	28.6887 29.2113	298.4671 294.6761	302.2848 295.1408
		Difference of Mean Scores		−2.1010 t=−1.2142	2.8665 t=1.2571	.7520 t=1.3775	−.5226 t=−.7966	3.7910 t=1.2199	7.1440 t=3.9051*
	Science	Boys (136) Girls (62)	Mean Scores	302.8603 303.8710	319.3162 314.2581	28.5147 28.3871	29.3529 29.1774	298.7557 290.9492	305.8309 295.9032
		Difference of Mean Scores		−1.0107 t=−.6111	5.0581 t=2.3805*	.1276 t=.2651	.1755 t= .2930	7.8066 t=4.2280*	9.9277 t=5.0979*
1960-1961	Mathematics	Boys (143) Girls ([illegible])	Mean Scores	303.0221 303.4559	320.6397 318.1045	27.2628 26.4923	28.7372 28.9385	301.0074 295.0000	300.2794 289.6269
		Difference of Mean Scores		− .4339 t=−.2816	2.5352 t=1.1457	.7705 t=1.3546	−.2013 t=−.3246	6.0074 t=3.7418*	10.6525 t=5.8595*
	Science	Boys (59) Girls (16)	Mean Scores	302.2941 306.0000	314.9423 315.2143	26.9038 29.2500	28.1731 29.9166	297.5490 289.7857	300.2830 291.9286
		Difference of Mean Scores		−3.7059 t=−.9171	−.2720 t=−.0869	−2.3462 t=−1.9396	−1.7435 t=−1.2535	7.7633 t=1.6727	8.3544 t=2.5186*

* Significance at 1.96.

Table C indicates that the SCAT-Verbal scores are consistently higher for girls than boys although the differences are not significant when t-tested. In the spring administration of the SCAT-Quantitative the boys were higher than the girls in three of the four courses, with one of these differences statistically significant. In FAS Scale 1 the boys did better than the girls, with the exception of the Science for the Space Age II students. The girls were better in three of four comparisons on the FAS Scale II test with none of the differences statistically significant. In the STEP Mathematics the boys were significantly superior to the girls. The boys also had a significant STEP Science gain in each course.

TABLE D

Differences between Boys and Girls on Mean Scores on Each Staff-Constructed Unit Test and Final Achievement Tests

	Course	Sex		Unit Tests II	III	IV	V	VI	VII	Final
1959 - 1960	Mathematics	Boys (161)	Mean Scores	71.7484	68.9623	75.1582	72.7659	73.2642	76.4085	75.9000
		Girls (72)		76.3888	73.2638	77.2083	74.0833	71.6805	78.9846	74.1666
		Difference of Mean Scores		−1.6404 t=−.7206	−4.3015 t=1.8084	−2.0501 t=−1.0475	−1.3174 t=−.5860	1.5837 t=1.3323	−2.5761 t=−1.2974	1.7334 t=1.2975
	Science	Boys (136)	Mean Scores	33.3407	29.8456	31.7926	18.3158	37.1967	22.2348	60.6587
		Girls (62)		29.9032	26.1935	30.5000	15.5645	31.2069	23.8710	57.1452
		Difference of Mean Scores		3.4375 t=2.8510*	3.6521 t=3.4110*	1.2926 t=1.0906	2.7513 t=1.7667	5.9898 t=2.1186*	−1.6362 t=−1.8826	3.5135 t=1.3380
1960 - 1961	Mathematics	Boys (143)	Mean Scores	79.1818	79.2624	82.8881	79.0423	86.7071	79.6738	78.7465
		Girls (72)		79.8873	73.7571	75.6250	77.0416	86.9571	78.2000	75.8194
		Difference of Mean Scores		.7055 t= .3821	5.5053 t=3.0148*	7.2631 t=4.5995*	2.0007 t=1.1010	−.2500 t=−.1295	1.4738 t=.8846	2.9271 t=1.5051
	Science	Boys (59)	Mean Scores	23.2414	31.2241	29.6207	20.4912	20.4912	29.0545	62.9123
		Girls (16)		19.9333	13.1333	25.4666	16.6000	13.1333	21.2666	51.4000
		Difference of Mean Scores		3.3081 t=2.5834*	18.0908 t=12.0053*	4.1541 t=2.7846*	3.8912 t=2.0611*	7.3579 t=5.5628*	7.7879 t=4.0362*	11.5123 t=2.9110*

* Significance at 1.96.

In Concepts of Mathematics I the girls did better than the boys on five of seven tests, although none of the differences was statistically significant. In Science for the Space Age I the boys were higher on six of seven tests, and three of the six differences were significant. In Concepts of Mathematics II the boys showed higher test marks on six of seven tests, with only two of the six differences significant. The boys in Science for the Space Age II scored significantly higher than the girls on every test.

From these data the following conclusions were formed:

1. The boys enrolled in the program achieved better than the girls on the unit tests.
2. The boys in Science for the Space Age were better motivated than the girls by television.
3. There appeared very little difference between the sexes in mathematics achievement.
4. The girls did as well as the boys in Year I.
5. The boys did better on the tests in Year II than the girls.